Issued November 1967

SOIL SURVEY

Republic County, Kansas

UNITED STATES DEPARTMENT OF AGRICULTURE
Soil Conservation Service
In cooperation with
KANSAS AGRICULTURAL EXPERIMENT STATION

Major fieldwork for this soil survey was done in the period 1955 to 1961. Soil names and descriptions were approved in 1965. Unless otherwise indicated, statements in the publication refer to conditions in the county in 1961. This survey was made cooperatively by the Soil Conservation Service and the Kansas Agricultural Experiment Station; it is part of the technical assistance furnished to the Republic County Soil Conservation District.

HOW TO USE THIS SOIL SURVEY

THIS SOIL SURVEY of Republic County contains information that can be applied in managing farms and ranches; in selecting sites for roads, ponds, buildings, or other structures; and in appraising the value of tracts of land for agriculture, industry, or recreation.

Locating Soils

All the soils of Republic County are shown on the detailed map at the back of this publication. This map consists of many sheets that are made from aerial photographs. Each sheet is numbered to correspond with numbers shown on the Index to Map Sheets.

On each sheet of the detailed map, soil areas are outlined and are identified by symbols. All areas marked with the same symbol are the same kind of soil. The soil symbol is inside the area if there is enough room; otherwise, it is outside and a pointer shows where the symbol belongs.

Finding and Using Information

The "Guide to Mapping Units" can be used to find information in the survey. This guide lists all of the soils of the county in alphabetical order by map symbol. It shows the page where each kind of soil is described, and also the page for the capability unit and range site. It also lists the windbreak suitability group in which the soil has been placed.

Individual colored maps showing the relative suitability or limitations of soils for many specific purposes can be developed by using the soil map and information in the text. Interpretations not included in the text can be developed by grouping the soils according to their suitability or limitations for a particular use. Translucent material can be used as an overlay over the soil map and colored to show soils that have the same limitation or suitability. For example, soils that have a slight limitation for a given use can be colored green, those with a moderate limitation can be colored yellow, and those with a severe limitation can be colored red.

Farmers and those who work with farmers can learn about use and management of the soils in the soil descriptions and in the discussions of capability units, range sites, and windbreak groups.

Ranchers and others interested in range can find, under "Range Management," groupings of the soils according to their suitability for range, and also the plants that grow on each range site.

Engineers and builders will find under "Engineering Uses of Soils" tables that give estimated physical properties of the soils in the county and that name soil features that affect engineering practices and structures.

Scientists and others can read about how the soils were formed and how they are classified in the section "Formation and Classification of Soils."

Students, teachers, and others will find information about soils and their management in various parts of the text, depending on their particular interest.

Newcomers in Republic County may be especially interested in the section "General Soil Map," where broad patterns of soils are described. They may also be interested in the section "Additional Facts About the County."

Cover picture.—Parallel benches of Crete silt loam, 1 to 3 percent slopes, irrigated.

U.S. GOVERNMENT PRINTING OFFICE: 1967

For sale by the Superintendent of Documents, U.S. Government Printing Office
Washington, D.C. 20402

Contents

	Page
How this survey was made	1
General soil map	2
1. Crete-Butler-Hastings association	2
2. Hastings-Crete-Geary association	4
3. Kipson-Tully-Crete association	4
4. Lancaster-Hedville-Crete association	7
5. Muir-Carr-Humbarger association	8
Descriptions of the soils	10
Breaks-Alluvial land	10
Butler series	11
Carr series	11
Crete series	11
Detroit series	12
Englund series	13
Eudora series	13
Geary series	14
Hastings series	15
Hedville series	17
Hobbs series	17
Humbarger series	17
Kenesaw series	18
Kipson series	19
Lancaster series	19
Muir series	20
Ortello series	21
Rough broken land	21
Sarpy series	21
Tully series	22
Wet alluvial land	22
Use and management of soils	22
Capability groups of soils	23
Management of dryland capability units	23
Management of irrigated capability units	28
Predicted yields on dryland soils	30
Range management	32
Range sites	32
Estimated yields by range sites	35
Management of windbreaks	35
Windbreak suitability groups	35
Wildlife management	35
Engineering uses of soils	36
Engineering classification systems	38
Engineering properties of the soils	38
Engineering interpretations	41
Formation and classification of soils	41
Factors of soil formation	41
Parent material	46
Climate	46
Plants and animals	46
Relief	47
Time	47
Classification of soils	47
Additional facts about the county	56
History	56
Climate	57
Agriculture	60
Transportation and markets	60
Literature cited	60
Glossary	61
Guide to mapping units	Following 61

NOTICE TO LIBRARIANS

Series year and series number are no longer shown on soil surveys. See explanation on the next page.

Issued November 1967

EXPLANATION

Series Year and Series Number

Series year and number were dropped from all soil surveys sent to the printer after December 31, 1965. Many surveys, however, were then at such an advanced stage of printing that it was not feasible to remove series year and number. Consequently, the last issues bearing series year and number will be as follows:

Series 1957, No. 23, Las Vegas and Eldorado Valleys Area, Nev.
Series 1958, No. 34, Grand Traverse County, Mich.
Series 1959, No. 42, Judith Basin Area, Mont.
Series 1960, No. 31, Elbert County, Colo. (Eastern Part)
Series 1961, No. 42, Camden County, N.J.
Series 1962, No. 13, Chicot County, Ark.
Series 1963, No. 1, Tippah County, Miss.

Series numbers will be consecutive in each series year, up to and including the numbers shown in the foregoing list. The soil survey for Tippah County, Miss., will be the last to have a series year and series number.

SOIL SURVEY OF REPUBLIC COUNTY, KANSAS

BY C. H. ATKINSON AND DONALD A. GIER, SOIL CONSERVATION SERVICE

UNITED STATES DEPARTMENT OF AGRICULTURE, SOIL CONSERVATION SERVICE, IN COOPERATION WITH THE KANSAS AGRICULTURAL EXPERIMENT STATION

REPUBLIC COUNTY has an area of 460,160 acres, or 719 square miles. The air mileage from Belleville, the county seat, to Topeka, the State capital, and to other towns and cities is shown in figure 1.

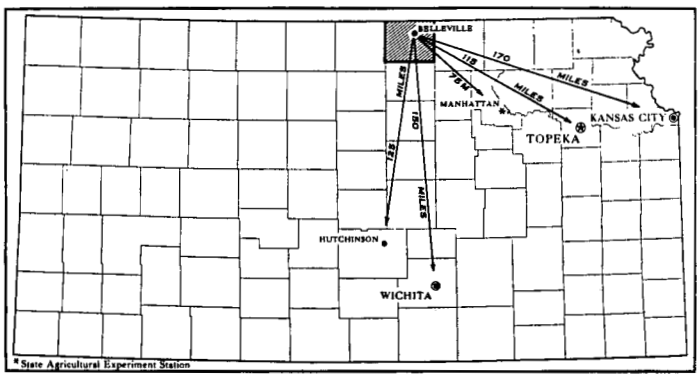


Figure 1.—**Location of Republic County in Kansas.**

Agriculture is the main enterprise in Republic County. Nearly all of the land in the county is privately owned and is occupied by farms of various sizes. Wheat, corn, grain sorghum, and cattle provide most of the income, though sales of alfalfa hay, milk, cream, and poultry products are important. Most of the farmland is cultivated, but nearly all farms maintain some native grass range or some pasture of tame grass. On the shallow soils in the southern half of the county, east of the Republican River, a large acreage is in native grass.

In the western part of the county, irrigation farming is being developed by the Bostwick Irrigation District. In other areas much of the cropland is irrigated from wells, streams, and ponds. Most of the irrigation on individual farms is in the valley of the Republican River. Some fields in the area extending from Republic northeastward to Chester, Nebr., are irrigated. The type of farming on these irrigated farms is cash-grain or cash-grain and cattle, and the kinds of crops are those commonly grown in the county.

Most of the arable soils on uplands have a dark-colored silty surface layer and a silty to clayey subsoil. These soils developed in deep loessal deposits on slopes that are generally gentle or moderate. Water erosion is the main hazard on these soils. The soils on uplands are suited to most crops commonly grown in the county.

The soils on flood plains and terraces have a loamy surface layer underlain by a silt loam, sandy loam, or clay loam subsoil. These soils developed on moderately sandy to moderately clayey alluvial deposits that generally are underlain by more sandy sediments. Crops on these soils produce moderate to high yields; most areas are well suited to irrigation.

How This Survey Was Made

Soil scientists made this survey to learn what kinds of soils are in Republic County, where they are located, and how they can be used.

They went into the county knowing they likely would find many soils they had already seen, and perhaps some they had not. As they traveled over the county, they observed steepness, length, and shape of slopes; size and speed of streams; kinds of native plants or crops; kinds of rock; and many facts about the soils. They dug many holes to expose soil profiles. A profile is the sequence of natural layers, or horizons, in a soil; it extends from the surface down into the parent material that has not been changed much by leaching or by roots of plants.

The soil scientists made comparisons among the profiles they studied, and they compared these profiles with those in counties nearby and in places more distant. They classified and named the soils according to nationwide, uniform procedures. To use this survey efficiently, it is necessary to know the kinds of groupings most used in a local soil classification.

Soils that have profiles almost alike make up a soil series. Except for different texture in the surface layer, all the soils of one series have major horizons that are similar in thickness, arrangement, and other important characteristics. Each soil series is named for a town or other geographic feature near the place where a soil of that series was first observed and mapped. Crete and Hastings, for example, are the names of two soil series. All the soils in the United States having the same series name are essentially alike in those characteristics that go with their behavior in the natural landscape. Soils

of one series can differ somewhat in texture of the surface soil and in slope, or some other characteristic that affects use of the soils by man.

Many soil series contain soils that differ in texture of their surface layer. According to such differences in texture, separations called soil types are made. Within a series, all the soils having a surface layer of the same texture belong to one soil type. Hastings silt loam and Hastings silty clay loam are two soil types in the Hastings series. The difference in texture of their surface layers is apparent from their names.

Some types vary so much in slope, degree of erosion, number and size of stones, or some other feature affecting their use, that practical suggestions about their management could not be made if they were shown on the soil map as one unit. Such soil types are divided into phases. The name of a soil phase indicates a feature that affects management. For example, Crete silt loam, 1 to 3 percent slopes, is one of two phases of Crete silt loam, a soil type that ranges from nearly level to gently sloping.

After a guide for classifying and naming the soils had been worked out, the soil scientists drew the boundaries of the individual soils on aerial photographs. These photographs show woodlands, buildings, field borders, trees, and other details that greatly help in drawing boundaries accurately. The soil map in the back of this survey was prepared from the aerial photographs.

The areas shown on a soil map are called mapping units. On most maps detailed enough to be useful in planning management of farms and fields, a mapping unit is nearly equivalent to a soil type or a phase of a soil type. It is not exactly equivalent, because it is not practical to show on such a map all the small, scattered bits of soil of some other kind that have been seen within an area that is dominantly of a recognized soil type or soil phase.

In preparing some detailed maps, the soil scientists have a problem of delineating areas where different kinds of soils are so intricately mixed, and so small in size that it is not practical to show them separately on the map. Therefore, they show this mixture of soils as one mapping unit and call it a soil complex. Ordinarily, a soil complex is named for the major kinds of soil in it, for example, Lancaster-Hedville loams, 5 to 25 percent slopes. Also, on most soil maps, areas are shown that are so rocky, so shallow, or so frequently worked by wind and water that they scarcely can be called soils. These areas are shown on a soil map like other mapping units, but they are given descriptive names, such as Rough broken land or Wet alluvial land, and are called land types rather than soils.

The soil scientist may also show as one mapping unit two or more soils that are mapped as one unit because their differences are not significant enough that it is necessary to show them as separate units on the soil map. This kind of mapping unit is called an undifferentiated soil group; an example is Hastings and Crete soils, 3 to 7 percent slopes, severely eroded.

While a soil survey is in progress, samples of soils are taken, as needed, for laboratory measurements and for engineering tests. Laboratory data from the same kinds of soils in other places are assembled. Data on yields of crops under defined practices are assembled from farm records and from field or plot experiments on the same kinds of soils. Yields under defined management are estimated for all the soils.

But only part of a soil survey is done when the soils have been named, described, and delineated on the map, and the laboratory data and yield data have been assembled. The mass of detailed information then needs to be organized in a way that it is readily useful to different groups of readers, among them farmers, ranchers, managers of woodland, engineers, and homeowners. Grouping soils that are similar in suitability for each specified use is the method of organization commonly used in the soil survey. On the basis of yield and practice tables and other data, the soil scientists set up trial groups, and then test them by further study and by consultation with farmers, agronomists, engineers, and others. The scientists then adjust the groups according to the results of their studies and consultation. Thus, the groups that are finally evolved reflect up-to-date knowledge of the soils and their behavior under present methods of use and management.

General Soil Map

The general soil map at the back of this survey shows, in color, the soil associations in Republic County. A soil association is a landscape that has a distinctive proportional pattern of soils. It normally consists of one or more major soils and at least one minor soil, and it is named for the major soils. The soils in one association may occur in another, but in a different pattern.

A map showing soil associations is useful to people who want a general idea of the soils in a county, who want to compare different parts of a county, or who want to know the location of large tracts that are suitable for a certain kind of farming or other land use. Such a map is not suitable for planning the management of a farm or field, because the soils in any one association ordinarily differ in slope, depth, stoniness, drainage, and other characteristics that affect management.

Following are descriptions of the five soil associations in Republic County.

1. Crete-Butler-Hastings Association

Nearly level to undulating, deep soils developed in loess

This soil association of deep, dark-colored soils occurs in all parts of the county. The landscape is nearly level to undulating, and the streams are shallowly entrenched. The steepest slopes are along the larger streams. This soil association makes up more than 180,000 acres, or about 40 percent of the county. Figure 2 shows a typical distribution of many of the soils in this association.

Crete soils are dominant in this association. They have a dark-colored, mellow, loamy surface layer. The friable silty clay loam in the upper part of the subsoil grades to dense silty clay in the lower part.

The Butler soils have a silt loam surface layer that is dark when moist but grayish when dry. The surface layer grades abruptly to dense silty clay in the upper

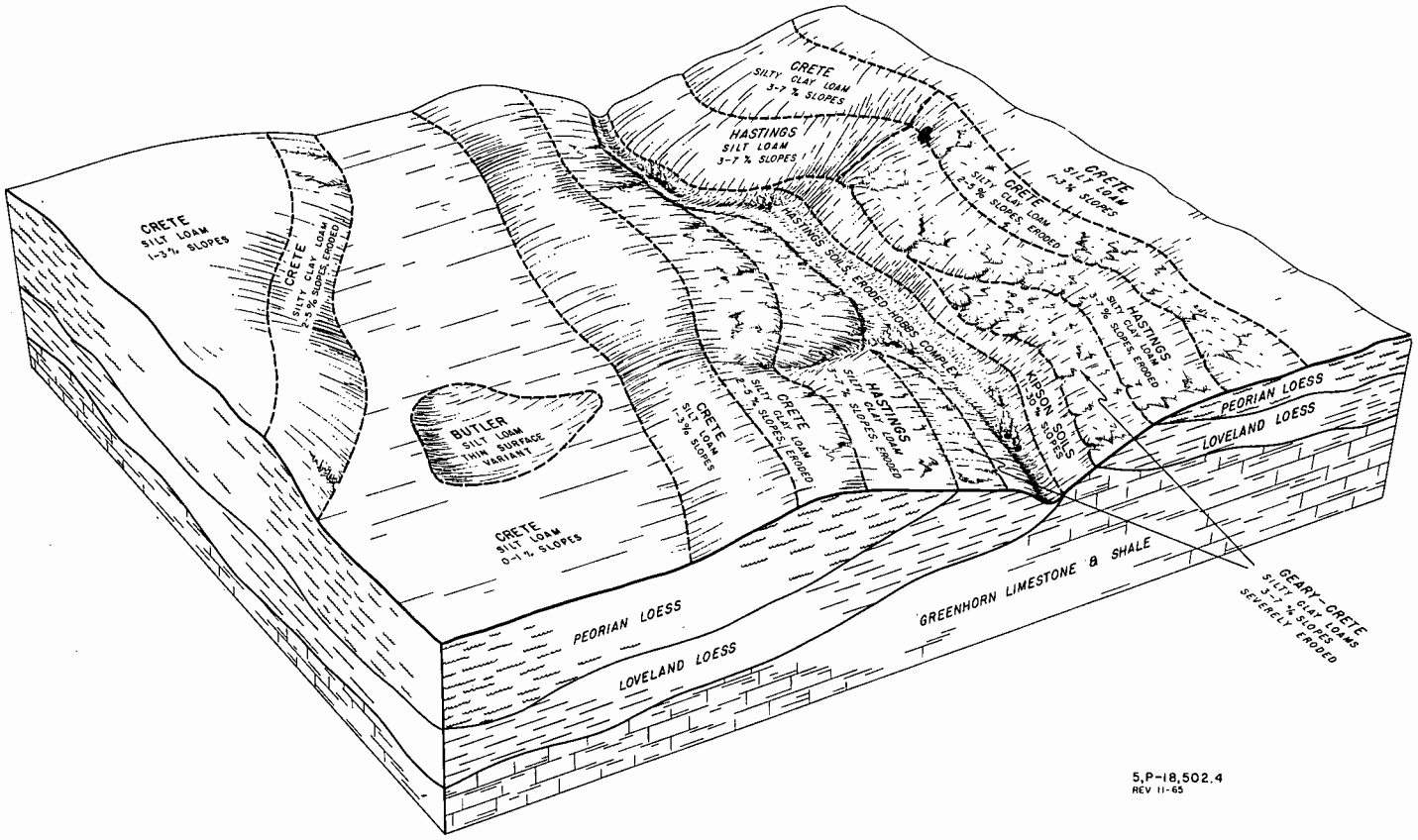


Figure 2.—Distribution of the soils in the Crete-Butler-Hastings association.

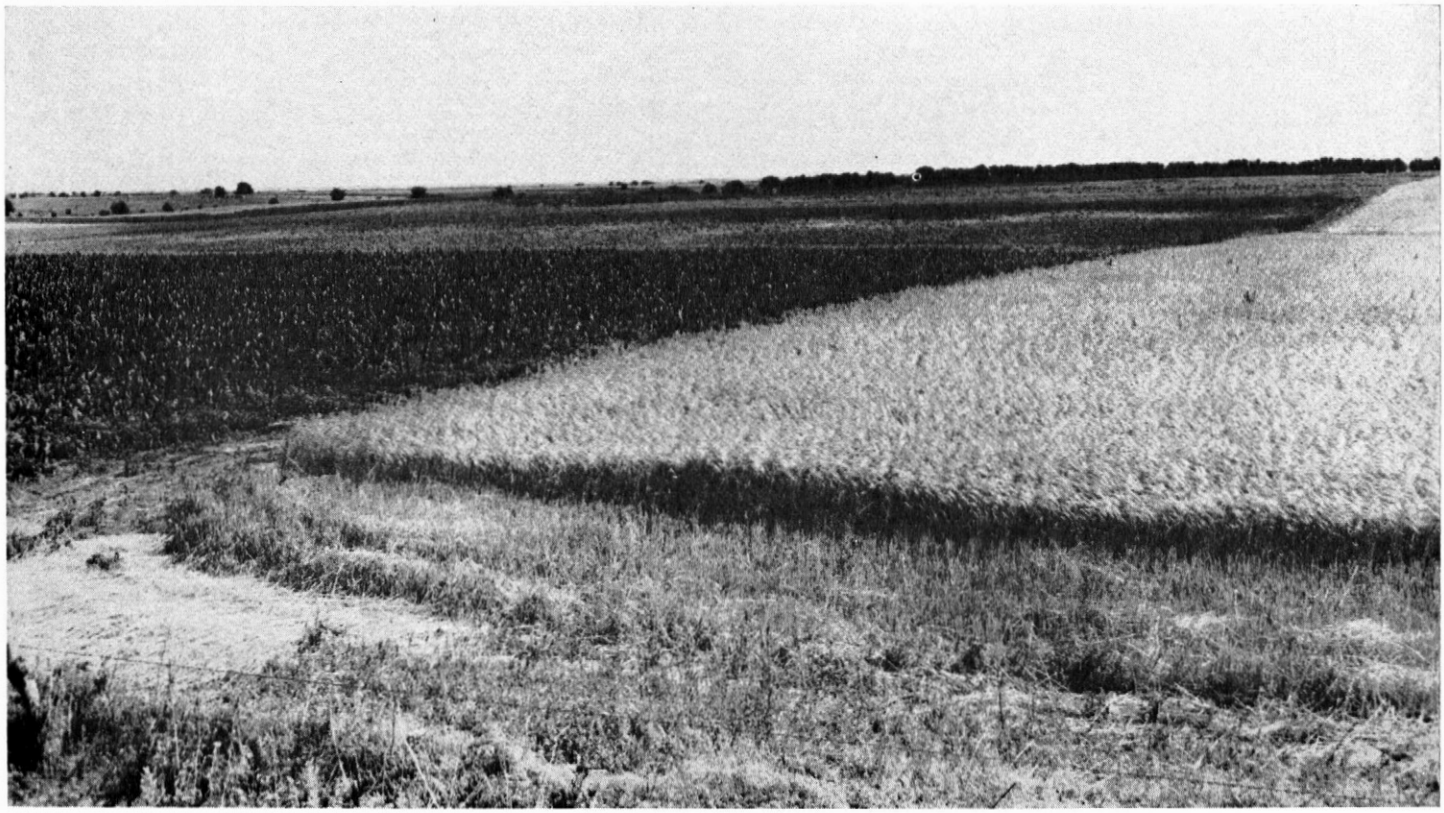


Figure 3.—Cropland in the Crete-Butler-Hastings association.

part of the subsoil. As depth increases, the subsoil grades to silty clay loam.

The dark-colored loamy surface layer of the Hastings soils ranges from 6 to 15 inches in thickness. The subsoil is thick and consists of grayish-brown or brown, friable silty clay loam.

The major soils of this association are moderately well drained to well drained and have slow or moderately slow permeability. Their surface layer is slightly acid, and their subsoil is slightly acid or neutral. The underlying material is alkaline to calcareous and contains varying amounts of free lime.

Also in this soil association are the Geary, Kipson, and Hobbs soils. The Geary and Kipson soils occur in narrow strips on the lowest part of some slopes. The Geary soils have a dark-colored loamy surface layer and a reddish silty clay loam subsoil. They occur on side slopes. The very shallow Kipson soils are on steep slopes where streams have cut deep enough to expose limestone and shale. The Hobbs soils are on the bottom lands along the larger local streams. They have a thick, dark-colored silt loam surface layer and a friable silty clay loam subsoil.

Most of this soil association is cultivated (fig. 3). Moderate to high yields of the crops commonly grown in the county are produced. The type of farms is mainly cash-grain or cash-grain and cattle. A moderate acreage is in pasture, and farm feedlots are common. This association makes up most of the irrigated upland in the Bostwick Irrigation District, and here crop yields are high under good irrigation practices.

Loss of water and soil is the main problem in maintaining productivity. The soils are well suited to winter wheat and grain sorghum.

2. Hastings-Crete-Geary Association

Sloping to rolling, deep soils developed in loess and mixed materials

This association occurs in the uplands throughout the county. The landscape is generally rolling; slopes are long, and streams are deeply entrenched (fig. 4). This soil association covers almost 120,000 acres, or about 26 percent of the county.

The major soils in this association are the Hastings, Crete, and Geary. The Hastings soils have a grayish-brown loamy surface layer that grades to a grayish-brown or brown, friable silty clay loam subsoil.

The Crete soils have a dark-colored loamy surface layer that gradually grades to a grayish-brown subsoil. The subsoil is silty clay loam in the upper part and silty clay in the lower part. The lower part of the subsoil is very firm.

The Geary soils have a brown or reddish-brown loamy surface layer that grades to a brown to reddish-brown, friable silty clay loam subsoil.

The major soils of this association are well drained and have slow to moderately slow permeability. Their surface layer is slightly acid, and their subsoil is slightly acid or neutral. In eroded areas the plow layer is neutral in some places. The underlying material is alkaline to calcareous and contains varying amounts of free lime. In this association most cultivated areas are moderately eroded or severely eroded.

The minor soils in this association are the Kenesaw, Kipson, and Muir, and Breaks-Alluvial land complex. The deep, well-drained Kenesaw soils have a soft silt loam surface layer and substratum. These soils are on steep slopes bordering the valley of the Republican River. The Kipson soils are shallower over bedrock. They have a dark-colored surface layer that grades to partly weathered limestone and shale. Kipson soils occur on gentle to steep slopes in all parts of the county. Breaks-Alluvial land complex is made up of narrow bottom lands and the adjacent, short, steep slopes on uplands. The Muir soils lie on second bottoms in the valleys throughout the county. They are deep and well drained and have a thick, dark-colored surface layer over a silty clay loam subsoil.

The position of the soils in the landscape varies according to location in the county. In the northeastern quarter, and the eastern half of the southwestern quarter, Crete soils occur on the ridgetops and Hastings soils, Geary soils, or both, occur on the side slopes. The Kipson soils occur on the lower part of slopes where streams have deeply cut into the underlying limestone and shale.

In the western half of the county, north and east of the town of Republic, this association consists mostly of Hastings and Geary soils, though small areas of Crete soils are on some hilltops. Along both sides of the valley of the Republican River, Hastings soils are on the gentle slopes and Kenesaw and Geary soils are on the steeper slopes. The Kipson soils are on the steep slopes near the drainageways and on the steep walls of the valleys.

In the southeastern quarter of the county, Crete soils occur on the broader, smooth hilltops and Hastings soils are on the steeper side slopes. Breaks-Alluvial land complex and Kipson soils are on the slopes below the Hastings soils. Throughout this association, Breaks-Alluvial land complex occurs along the deeply entrenched streams. Adjacent to this land type, in the larger valleys, are areas of Muir soils on nearly level terraces.

Most of the acreage in this soil association is cultivated (fig. 5). Yields from all crops commonly grown in the county are moderate to good. The broken and steep rough areas are generally used for pasture or native range. One-fourth of this soil association is pasture. The farms are mainly cash-grain farms and cash-grain and cattle farms.

3. Kipson-Tully-Crete Association

Rolling, deep and shallow soils developed in loess and limestone-shale materials

This association consists of shallow and deep soils on rolling uplands in the southern half of the county. A large area is east of the Republican River, and a smaller area is in the southwestern corner. The landscape is rolling; the long slopes are deeply cut by streams (fig. 6). The association occupies nearly 70,000 acres, or about 15 percent of the county.

The major soils are the Kipson, Tully, and Crete. The Kipson are shallow soils on narrow ridgetops, hill crests, and steep side slopes. The Tully are deep soils on foot slopes of the limestone and shale hills in nearly every

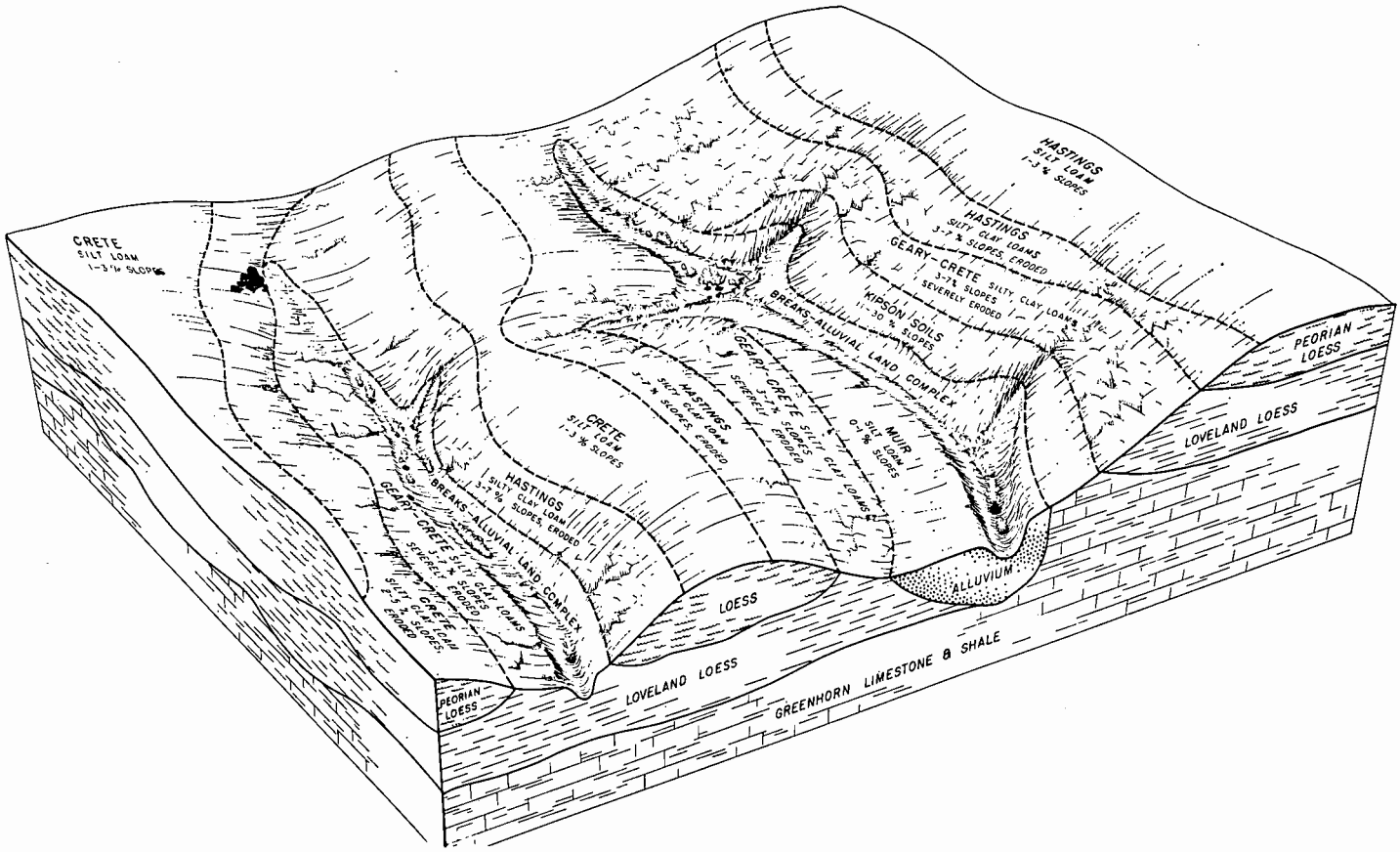


Figure 4.—Distribution of soils in the Hastings-Crete-Geary association.

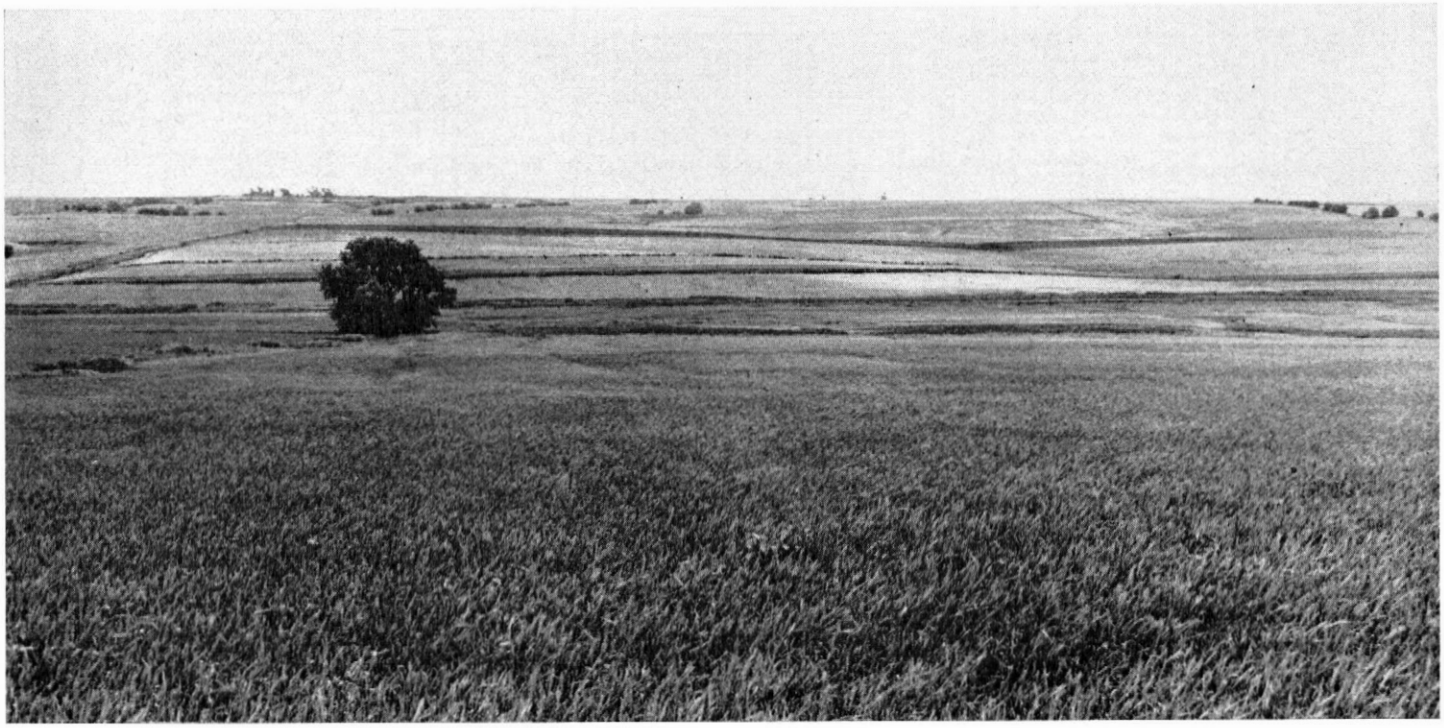


Figure 5.—Cropland and pasture in the Hastings-Crete-Geary association.

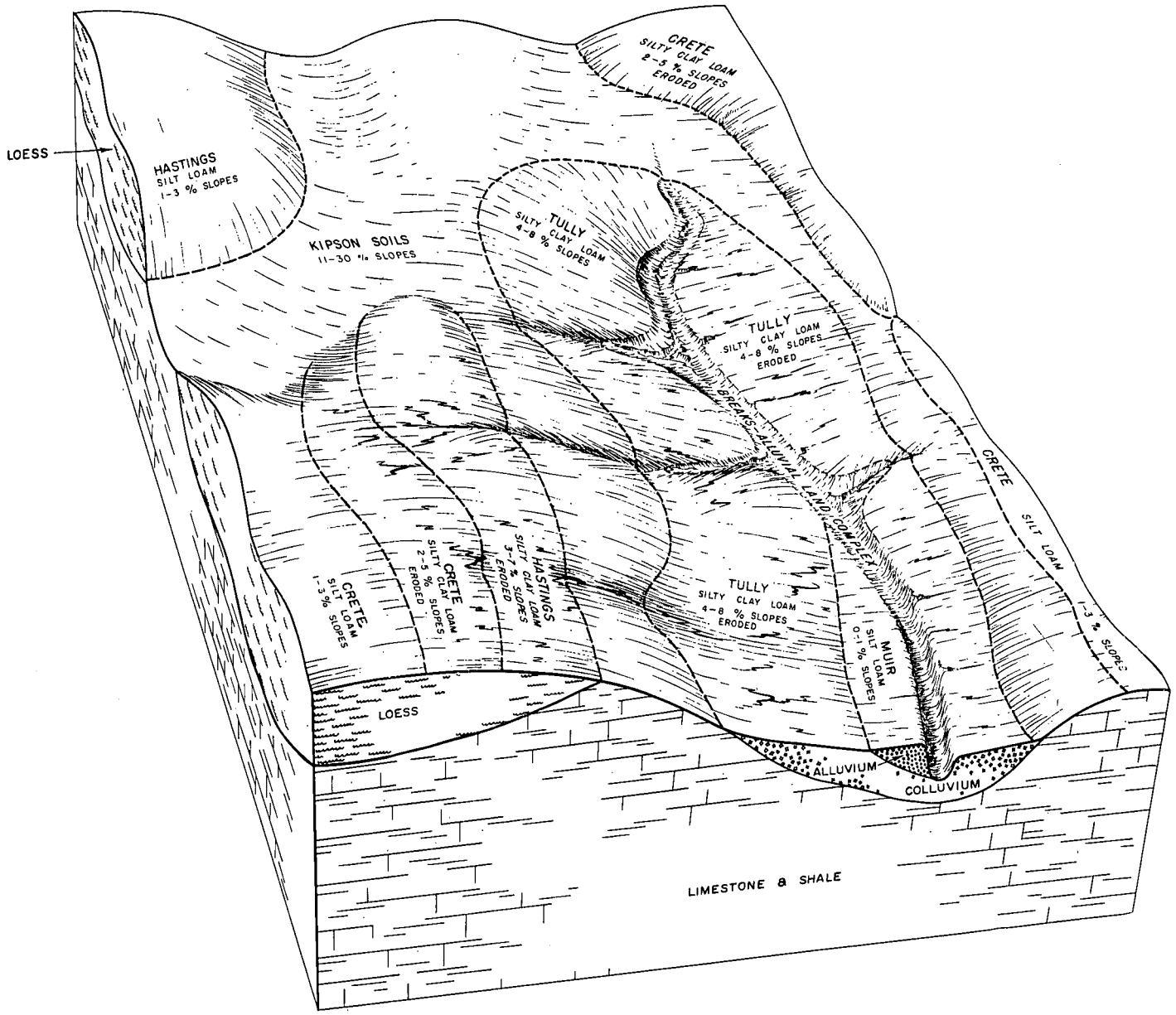


Figure 6.—**Distribution of the soils in the Kipson-Tully-Crete association.**

valley. The Crete are deep soils on the hilltops and in the wider valleys.

The Kipson soils have a dark-colored surface layer, 5 to 15 inches thick, that consists of shaly silt loam, stony silt loam, or stony loam. The surface layer grades to partly weathered rock. In many places bedrock crops out at the surface.

The Tully soils have a brownish silty clay loam surface layer. This layer grades to a brown to reddish-brown silty clay loam subsoil.

The Crete soils have a dark-colored loamy surface layer. This layer grades to silty clay loam in the upper part of the subsoil. The subsoil grades to firm, grayish-brown silty clay in the lower part.

The Tully and Crete soils are well drained and have slow to moderately slow permeability. They are slightly acid in the surface layer, slightly acid or neutral in the subsoil, and alkaline to calcareous in the substratum. The substratum contains varying amounts of free lime. The Kipson soils are excessively drained and are calcareous throughout.

Minor soils in this soil association are the Hastings, Lancaster, and Muir soils and Breaks-Alluvial land complex. Hastings soils occupy the steeper slopes below the Crete soils. Hastings soils have a grayish-brown loamy surface layer and a brownish, friable silty clay loam subsoil. The Lancaster soils occur with the Hastings soils on the lower slopes of some low-lying hills in the valleys. Lancaster soils have a brown loam surface layer and a reddish-brown clay loam subsoil. In the larger valleys, the Muir soils are on the nearly level terraces. They have a thick, dark-colored surface layer and a fri-

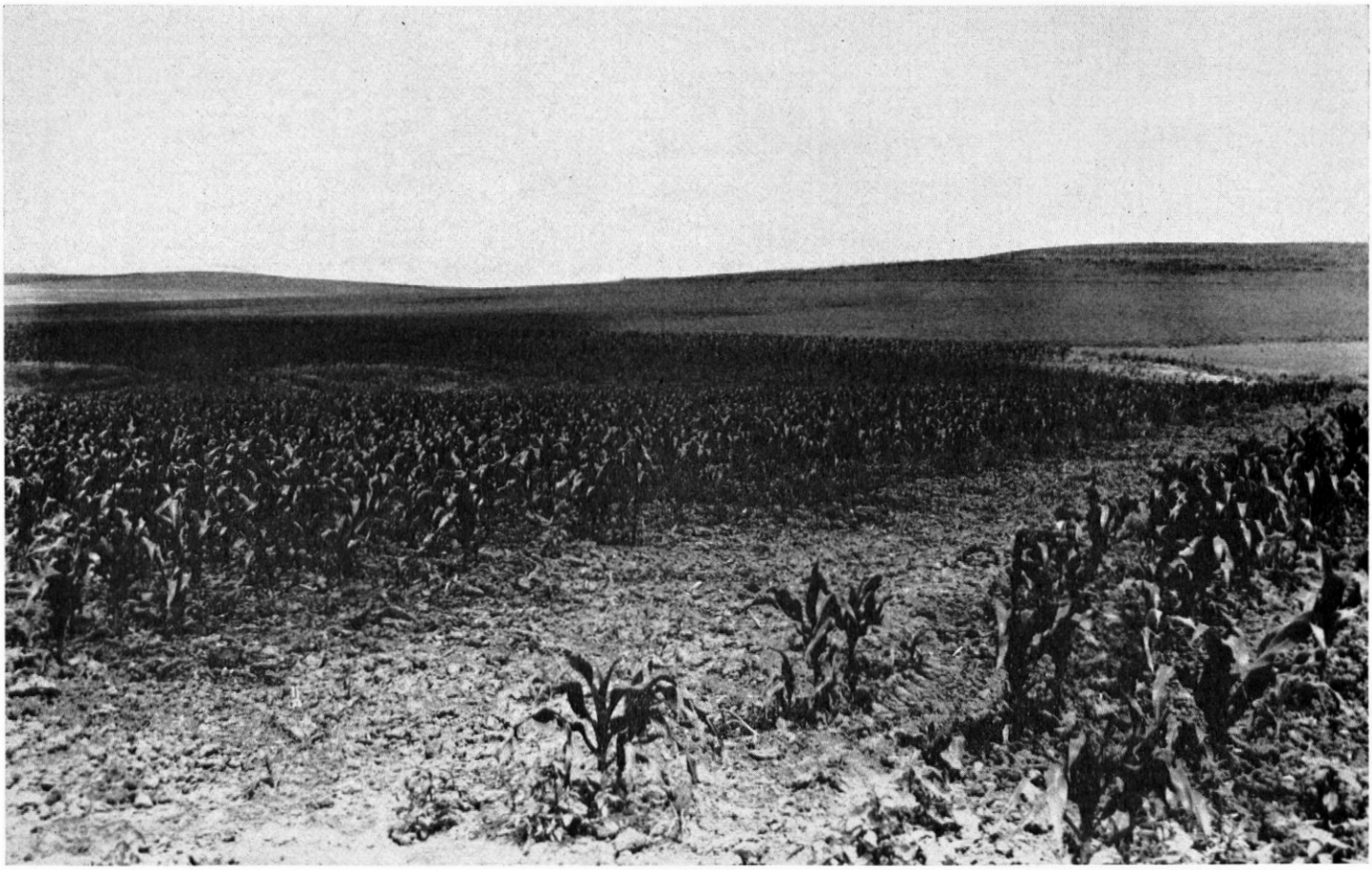


Figure 7.—Cropland in foreground and rangeland in background in the Kipson-Tully-Crete association.

able silty clay loam subsoil. Breaks-Alluvial land complex occurs in the valleys where streams are deeply entrenched. It consists of narrow bottom lands and adjacent steep, broken side slopes.

In this soil association the acreage of cultivated land is only slightly larger than that of rangeland (fig. 7). All of the crops commonly grown in the county are produced on the deep soils, and yields are moderate. The shallow Kipson soils and the Breaks-Alluvial land complex are better suited to range than to crops and are used for range. The farms are mainly cash-grain farms and cattle farms.

4. Lancaster-Hedville-Crete Association

Sloping to rolling, deep and shallow soils developed in loess and sandstone-shale materials

This association of deep and shallow, dark-colored soils is in the uplands of the southeastern part of the county. The landscape is rolling; the slopes are of varying length and are shallowly to deeply cut by streams (fig. 8). This soil association makes up slightly more than 18,000 acres, or about 4 percent of the county.

The Lancaster soils, which formed in material derived from sandstone and shale, are on the moderately sloping, low-lying hills. They have a brown loam surface layer that grades to a subsoil of reddish-brown or reddish-yellow, friable clay loam. These soils are 24 to 60 inches deep to the sandstone and shale bedrock.

The Hedville soils occur on narrow hilltops and steep side slopes. Their dark-colored gravelly or stony loam surface layer is 5 to 15 inches thick, and it grades to partly weathered sandstone and shale. Bedrock crops out in many places, and there are many large stones on the surface.

The Crete soils have a dark-colored loamy surface layer. This layer grades to the subsoil, which in the upper part is of much the same texture as the surface layer, but grades to firm, grayish-brown silty clay in the lower part.

The Lancaster and Crete soils are well drained, and the Hedville soils are excessively drained. The Lancaster soils have slow to moderately slow permeability. Their surface layer is medium acid, their subsoil is slightly acid, and their substratum is neutral. In the Crete soils, the surface layer is slightly acid, the subsoil is neutral, and the substratum is alkaline to calcareous and contains varying amounts of free lime. The Hedville soils have an acid surface layer; they overlie sandstone and shale.

Also in this soil association are the Hastings, Kipson, Tully, and Englund soils, and Breaks-Alluvial land complex. The Hastings soils occur with the Crete and are on moderate to steep slopes. Hastings soils have a grayish-brown loamy surface layer and a brownish, fri-

234-641—67—2

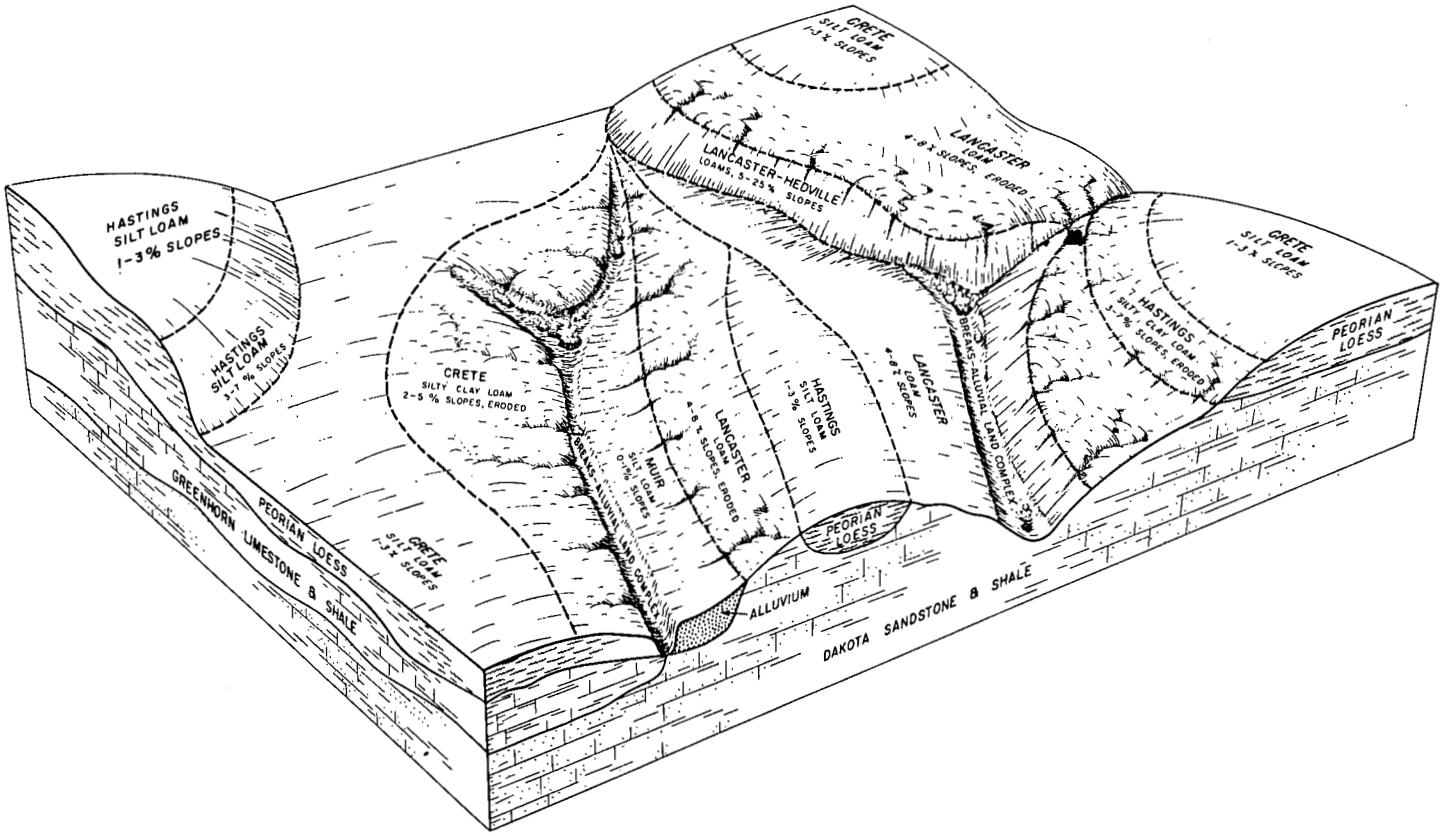

HASTINGS SILT LOAM 1-3% SLOPES
HASTINGS SILT LOAM 3-7 % SLOPES
CRETE SILTY CLAY LOAM 2-5 % SLOPES, ERODED
GREENHORN LIMESTONE & SHALE
PEORIAN LOESS
CRETE SILT LOAM 1-3 % SLOPES
MUIR SILT LOAM 0-1% SLOPES
LANCASTER SOILS, 4-8 % SLOPES, ERODED
BREAKS-ALLUVIAL LAND COMPLEX
HASTINGS SILT LOAM 1-3% SLOPES
LANCASTER LOAM 4-8 % SLOPES
ALLUVIUM
DAKOTA SANDSTONE & SHALE
LANCASTER-HEDVILLE LOAMS, 5-25 % SLOPES
LANCASTER LOAM 4-8 % SLOPES, ERODED
HASTINGS SILTY CLAY LOAM 3-7 % SLOPES, ERODED

Figure 8.—**Distribution of soils in the Lancaster-Hedville-Crete association.**

able silty clay loam subsoil. The Kipson soils are very shallow to shallow over limestone and shale, and their surface layer is darker colored than that of the Lancaster or Hedville soils.

The Tully soils, which developed on colluvium, occur on low-lying foot slopes. They have a dark-colored or brownish silty clay loam surface layer and a brown to reddish-brown silty clay loam subsoil. The Englund soils, which developed on shale, occur with the Lancaster and Hedville soils. The surface layer of the Englund soils is dark-colored silty clay loam, and the subsoil is silty clay. Breaks-Alluvial land complex consists of dark-colored bottom lands and the adjoining, steep broken slopes.

The acreage of cultivated land in this association is only slightly larger than that of rangeland. The Lancaster and Crete soils produce all crops commonly grown in the county, and yields are fair to moderate. The cultivated areas of Hedville soils, and of other shallow soils, would provide better returns if they were seeded to grass. The farms are mainly cash-grain farms and cattle farms.

5. Muir-Carr-Humbarger Association

Nearly level to gently undulating soils formed in alluvium on flood plains and terraces

This soil association is made up of soils on flood plains and terraces in the valley of the Republican River and in other large valleys (fig. 9). The landscape is either nearly level or gently undulating, and generally an area having strong slopes separates the two kinds of topography. This association covers 65,000 acres, or about 15 percent of the county. Most of it is in the valley of the Republican River.

The major soils in this association are the Muir, Carr, and Humbarger. The Muir soils formed in medium-textured sediments on nearly level terraces. These soils have a thick, dark-colored silt loam surface layer over a friable, grayish-brown silt loam to silty clay loam subsoil.

The Carr soils have a grayish-brown fine sandy loam surface layer over a brownish fine sandy loam subsoil. They formed on deposits of stratified sand and silt that contain minor strata of clay. In places loose, coarse layers of sand occur at varying depths below the surface layer.

The Humbarger soils have a dark grayish-brown loam or clay loam surface layer over a grayish-brown, friable silt loam or clay loam subsoil. These soils developed on deposits of silt and clay that contain minor strata of sand. In places layers of loose, coarse sand are at varying depths below the surface layer.

The major soils in this association are well drained and have moderately slow or moderate permeability. The Carr and Humbarger soils are calcareous throughout their profile. The Muir soils are very slightly acid in the surface layer, neutral in the subsoil, and alkaline to calcareous in the substratum.

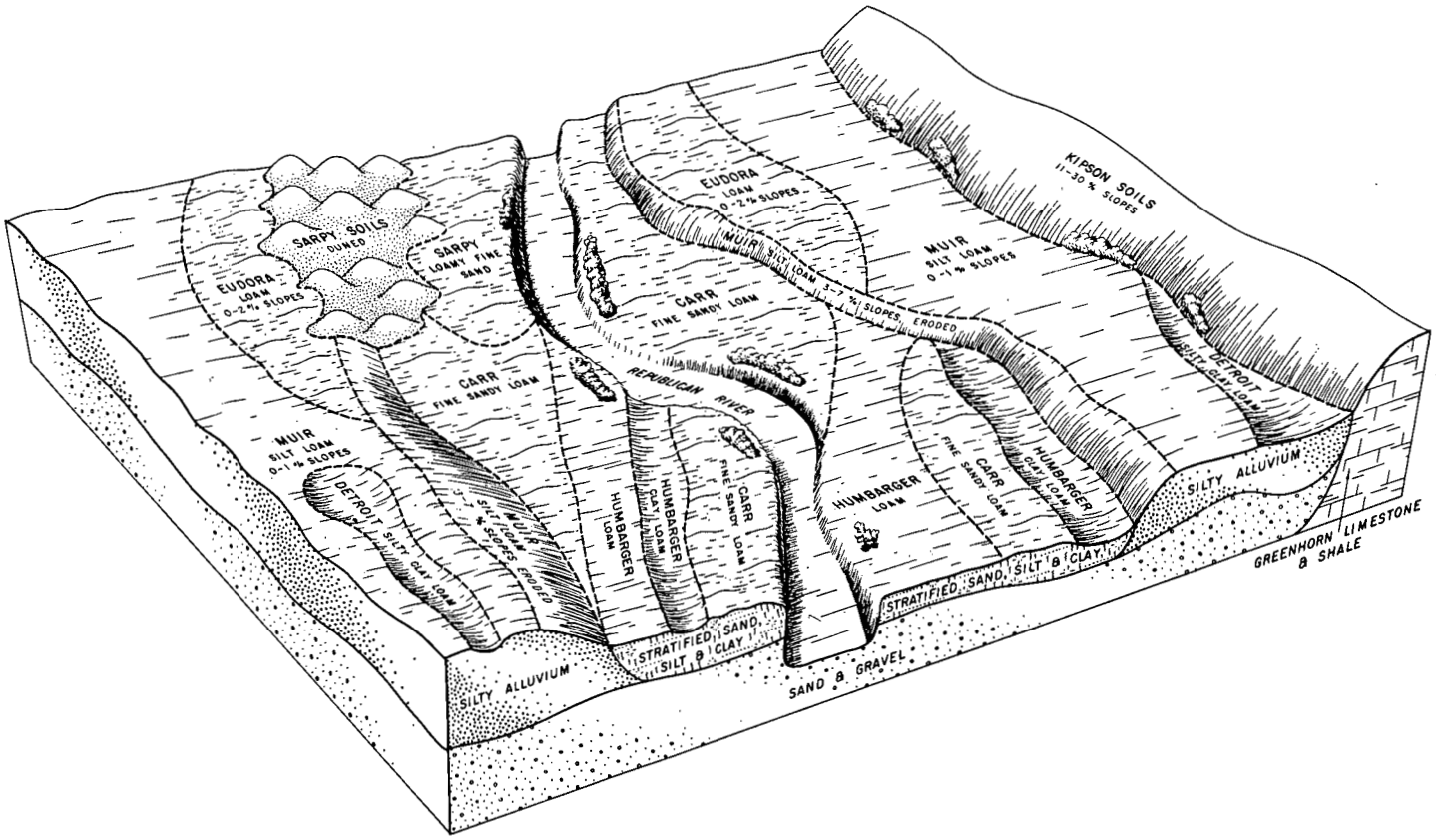


Figure 9.—Distribution of soils in the Muir-Carr-Humbarger association.

Figure 10.—Cropland in the Muir-Carr-Humbarger association in the valley of the Republican River. The unmowed strip is on an escarpment between the bottom land on the left and terraces on the right.

Also in this association are the Sarpy, Hobbs, Eudora, and Detroit soils and Wet alluvial land. The Sarpy soils are loamy sands or loamy fine sands on flood plains and terraces. They are associated with the Carr and Humbarger soils along the Republican River. The Hobbs soils have a silt loam surface layer and a silt loam to silty clay loam subsoil. They occur on bottom lands in the local valleys and are associated with the Muir soils. Wet alluvial land consists of poorly drained material of silt loam and silty clay loam texture. It is on the flood plain of Cool Creek, southeast of Talmo, and around the State Lake in the southwestern corner of the county. The Eudora soils have a loam surface layer and a loam to fine sandy loam subsoil. The Detroit soils have a silty clay loam surface layer and a silty clay loam to silty clay subsoil. Both Eudora and Detroit soils occur on terraces in the valley of the Republican River.

The soils in this association are intensively cultivated, and crops produce moderate to high yields (fig. 10). These soils produce much of the feed and wheat used in the cash-grain and cash-grain and cattle farms that are prevalent in the county. Some special crops are grown in the valley of the Republican River. Most of the soils are well suited to irrigation and produce high yields of crops if good practices of irrigation are used.

Descriptions of the Soils

This section describes the soil series (groups of soils) and single soils (mapping units) of Republic County. The procedure is first to describe the soil series and then the mapping units in the series. Thus to get full information on any one mapping unit, it is necessary to read the description of that unit and also the description of the soil series to which it belongs.

Following the name of each mapping unit, there is a symbol in parentheses that identifies the mapping unit on the detailed soil map. The acreage and proportionate extent of each mapping unit are given in table 1.

Each mapping unit in the county has been placed in a dryland or irrigated capability unit, or both, and in a range site and a windbreak group, so that its use and management for crops, as rangeland, and for windbreaks can be readily discussed. The pages on which the capability unit, the range site, and the windbreak group are described can be found by referring to the "Guide to Mapping Units" at the back of this survey. This Guide also gives the page on which each soil in the county is described.

Soil scientists, engineers, students, and others who want detailed descriptions of the soil series should turn to the section "Formation and Classification of Soils." Many terms used in the soil descriptions and other sections are defined in the Glossary.

TABLE 1.—*Approximate acreage and proportionate extent of the soils*

Soil	Area	Extent
	Acres	*Percent*
Breaks-Alluvial land complex	40, 638	8. 8
Butler silt loam, thin surface variant	2, 862	. 6
Carr fine sandy loam	9, 718	2. 1
Crete silt loam, 0 to 1 percent slopes	16, 725	3. 6
Crete silt loam, 1 to 3 percent slopes	98, 496	21. 4
Crete silty clay loam, 3 to 7 percent slopes	3, 934	. 9
Crete silty clay loam, 2 to 5 percent slopes, eroded	52, 739	11. 5
Detroit silty clay loam	1, 142	. 2
Englund silty clay loam, 3 to 7 percent slopes	429	(1)
Eudora loam, 0 to 2 percent slopes	2, 091	. 5
Eudora loam, 2 to 8 percent slopes	243	(1)
Geary-Crete silt loams, 3 to 7 percent slopes	2, 206	. 5
Geary-Crete silty clay loams, 3 to 7 percent slopes, severely eroded	11, 442	2. 5
Hastings silt loam, 0 to 1 percent slopes	214	(1)
Hastings silt loam, 1 to 3 percent slopes	19, 162	4. 2
Hastings silt loam, 3 to 7 percent slopes	9, 073	2. 0
Hastings silty clay loam, 3 to 7 percent slopes, eroded	43, 338	9. 4
Hastings and Crete soils, 3 to 7 percent slopes, severely eroded	2, 602	. 6
Hastings-Ortello fine sandy loams, 1 to 4 percent slopes, eroded	632	. 1
Hastings-Ortello fine sandy loams, 4 to 8 percent slopes, eroded	1, 087	. 2
Hastings soils, eroded-Hobbs complex	48, 389	10. 5
Hobbs silt loam	2, 098	. 5
Humbarger clay loam	2, 819	. 6
Humbarger loam	6, 736	1. 5
Kenesaw silt loam, 5 to 12 percent slopes	464	. 1
Kenesaw silt loam, 5 to 12 percent slopes, eroded	734	. 2
Kipson soils, 11 to 30 percent slopes	26, 090	5. 7
Lancaster loam, 4 to 8 percent slopes	967	. 2
Lancaster loam, 4 to 8 percent slopes, eroded	3, 859	. 8
Lancaster-Hedville loams, 5 to 25 percent slopes	5, 071	1. 1
Muir silt loam, 0 to 1 percent slopes	22, 884	5. 0
Muir silt loam, 3 to 7 percent slopes, eroded	1, 474	. 3
Rough broken land	1, 406	. 3
Sarpy loamy fine sand	2, 261	. 5
Sarpy soils, duned	966	. 2
Tully silty clay loam, 4 to 8 percent slopes	2, 549	. 6
Tully silty clay loam, 4 to 8 percent slopes, eroded	8, 044	1. 7
Wet alluvial land	1, 596	. 3
Republican River	1, 717	. 3
State Lake	754	. 2
Ponds	403	(1)
Borrow pits	64	(1)
Sand and gravel pits	42	(1)
Total	460, 160	100. 0

[1] Less than 0.1 percent.

Breaks-Alluvial Land

Breaks-Alluvial land complex (Bk) occurs along the drainageways and larger creeks throughout the county. About 35 percent of the complex consists of soils on bottom lands, and about 65 percent consists of soils on adjoining steep, broken side slopes.

Alluvial land has a dark-colored, thick silt loam surface layer and a dark grayish-brown, friable silty clay loam subsoil. In some places the subsoil is made up of alternating layers of silt loam and silty clay loam. Surface drainage is medium or slow, and flooding is likely after moderate to heavy rains.

Deep soils occupy the steep, broken side slopes. These soils have a dark-colored silt loam or silty clay loam surface layer that overlies grayish-brown or reddish-brown weathered soil material of silty clay loam texture. Along the larger streams, the soils on side slopes have a

surface layer of silt loam that overlies strata of gray silt loam or silty clay loam. Narrow strips of sand, gravel, or bedrock crop out in places. The side slopes are cut by landslips, catwalks, or deep lateral drains. Except during long rainy seasons, these deep soils are excessively drained. Runoff is rapid.

Breaks-Alluvial land is suitable only as rangeland, windbreaks or woodlots, and wildlife areas. In some areas, the soils on bottom lands can be planted to crops commonly grown in the county. Both parts of complex, capability unit VIe–2 (dryland). Breaks part: Loamy Upland range site and windbreak suitability group 3. Alluvial land: Loamy Lowland range site and windbreak suitability group 1.

Butler Series

The Butler series consists of deep, moderately well drained soils that have a loamy surface layer abruptly underlain by a dense clayey subsoil. These soils developed in loess in slight depressions of the nearly level to gently undulating uplands. They are in the west-central, the north-central, and the northeastern parts of the county.

The dark-colored silt loam surface layer is about 8 inches thick and is easily worked when it is slightly moist or dry. When it is dry, it is grayish and loose. The surface layer is slightly acid.

The very firm subsoil, about 30 inches thick, is about equally divided into three parts. The dark-gray upper part grades to gray in the middle part. The upper two-thirds of the subsoil is very firm silty clay that has angular blocky structure and is extremely hard when dry and plastic when wet. The lower third is light brownish-gray silty clay loam that has angular blocky structure. In the lowest part of the subsoil, there are many, distinct, brown mottles and hard limy concretions.

Light-gray, friable, calcareous loess underlies the subsoil. It is partly weathered silty clay loam to a depth of 50 inches and is less weathered silt loam below that depth. Distinct, brown mottles and limy concretions are more numerous in the upper part of the underlying material than in the lower part.

The Butler soils have slow runoff and are ponded in places during and after rainy periods. Internal drainage and permeability are also slow.

The Butler soils can be used as cropland, rangeland, windbreaks, and wildlife areas. They are well suited to small grains and native grass. These soils are droughty in summer and are better suited to grain sorghum than to corn. The very firm subsoil restricts the roots of some trees planted in windbreaks. The productivity of ponded areas generally can be increased by installing surface drains.

Butler silt loam, thin surface variant (0 to 1 percent slopes) (Bu).—This soil—a variant of the series—is the only Butler soil mapped in the county. It generally occurs with Crete silt loam, 0 to 1 percent slopes, and minor areas of that soil are included in areas mapped as Butler silt loam, thin surface variant. This Butler soil is suitable for irrigation, and most of the cultivated acreage is irrigated. Capability unit IIs–2 (dryland), IIs–3 (irrigated); Clay Upland range site; windbreak suitability group 3.

Carr Series

The Carr series consists of well-drained, calcareous soils that have a loamy surface layer and subsoil over underlying material consisting of loose sand or sand and gravel. These soils occur on the nearly level to gently undulating flood plains of the Republican River.

The surface layer is light brownish-gray, loose, generally calcareous fine sandy loam about 7 inches thick. This layer is easily worked when it is moist or dry.

The upper part of the subsoil is light brownish-gray fine sandy loam, or it consists of layers of varying texture that on the average are fine sandy loam. The upper subsoil is very friable, calcareous, and about 18 inches thick. The lower subsoil is light-gray fine sandy loam to loamy fine sand, or it is made up of layers that range from fine sandy loam to loamy fine sand. It is loose and calcareous. In places the lower subsoil is faintly streaked or spotted with dark brown and yellowish brown. It is about 20 inches thick, and it overlies calcareous, loose sand or sand and gravel.

The Carr soils have medium internal drainage and slow runoff. Permeability is moderate, and moisture-holding capacity is moderate to moderately low. Cultivation is not restricted by the water table, which fluctuates between depths of 3 and 10 feet. The Carr soils are subject to flooding, and during droughts they are susceptible to wind erosion.

These soils are moderately to highly productive of the crops commonly grown in the county. They are used mainly for corn and grain sorghum. Native grass range, windbreaks or woodlots, and wildlife areas are also suitable uses. These soils are suitable for irrigation.

Carr fine sandy loam (0 to 2 percent slopes) (Ca) occurs as elongated and irregular areas of various sizes that are on the flood plain of the Republican River. Included in areas mapped as this soil are small areas of Humbarger loam and Sarpy loamy fine sand.

Carr fine sandy loam can be used for all of the crops commonly grown in the county, for truck crops, and as native range. Areas that are generally cultivated need to be covered with crop residue so that soil blowing is reduced during dry periods. Some areas are suitable for irrigation, but the depth to loose sand should be determined before leveling operations are begun. Capability unit IIw–1 (dryland), IIw–2 (irrigated); Sandy Lowland range site; windbreak suitability group 2.

Crete Series

The Crete series consists of deep, well-drained soils that have a loamy surface layer underlain by a clayey subsoil. These soils developed in loess on nearly level to gently undulating uplands throughout the county.

These soils have a dark-colored, slightly acid silty clay loam or silt loam surface layer about 12 inches thick. It is easily worked when it is slightly moist or dry. The very dark colored, mellow surface layer grades gradually to the underlying subsoil.

The subsoil, about 30 inches thick, has three parts. The upper part is dark grayish-brown silty clay loam that has fine subangular blocky structure. The middle part is dark grayish-brown to grayish-brown silty clay that has medium blocky structure and is extremely hard

when dry and plastic when wet. The lower part is light brownish-gray silty clay loam that is spotted with dark brown and has medium subangular blocky structure. Both the upper and middle parts of the subsoil are slightly acid. The lower part is neutral and contains many, small, hard concretions of lime.

Light brownish-gray, friable, calcareous loess underlies the subsoil. It is partly weathered silty clay loam to a depth of 48 inches and is less weathered silt loam below that depth. This layer is mottled distinctly with dark brown, yellow, and reddish yellow and contains soft and hard concretions of lime.

The Crete soils have slow to medium runoff and slow internal drainage and permeability. Natural fertility is high, and the moisture-holding capacity is good, but these soils are susceptible to water erosion.

These soils are used for all of the crops commonly grown in the county. They are well suited to wheat, hay, and native grasses. Also they are suitable as windbreaks and wildlife areas. Unless precipitation is especially favorable, grain sorghum is better suited to these soils than is corn. These soils are suitable for irrigation.

Crete silt loam, 0 to 1 percent slopes (Ce) occurs mainly in the west-central part and the northern half of the county. This soil is grayer and more mottled in the middle and lower parts of the subsoil than is the soil described for the series. Also, the zone of lime concretions is more prominent. In this soil the combined thickness of the surface layer and subsoil ranges from 30 to 40 inches.

Included in areas mapped as this soil are small areas of Butler silt loam, thin surface variant, and of Crete silt loam, 1 to 3 percent slopes.

Crete silt loam, 0 to 1 percent slopes, is used mainly for crops commonly grown in the county. Only a small acreage remains in native grass. Soil erosion is a slight problem. Because surface drainage, internal drainage, and permeability are slow, installing surface drains helps to improve productivity during wet years. Most of the acreage in the west-central part of the county and some areas in the north-central part are irrigated. Capability unit IIs–1 (dryland), IIs–3 (irrigated); Clay Upland range site; windbreak suitability group 3.

Crete silt loam, 1 to 3 percent slopes (Cf) occurs throughout the county. The surface layer of this soil ranges from 8 to 12 inches in thickness. The subsoil ranges from grayish brown or brown to light brownish gray and is weakly mottled in the lower part. The surface layer and the subsoil combined range from 28 to 36 inches in thickness.

Included in areas mapped as this soil are small areas of Butler silt loam, thin surface variant; Crete silt loam, 0 to 1 percent slopes; and Crete silty clay loam, 2 to 5 percent slopes, eroded.

Runoff is slow to medium; internal drainage and permeability are slow. Soil erosion is not serious.

This soil is used mainly as cropland, but a small acreage remains in native grass. Yields are often reduced because available moisture is lacking. Much of the acreage is irrigated. Capability unit IIe–1 (dryland), IIe–3 (irrigated); Clay Upland range site; windbreak suitability group 3.

Crete silty clay loam, 2 to 5 percent slopes, eroded (Cr) occurs throughout the county. Runoff is medium, and erosion has removed most of the original surface layer. The present surface layer is made up of 2 to 4 inches of the original surface layer and part of the upper subsoil. The surface layer is grayish-brown silty clay loam that is very sticky when wet and hard when dry. A few small spots of silty clay occur in this layer.

The subsoil ranges from 18 to 28 inches in thickness. The upper part of the subsoil ranges from dark grayish-brown silty clay loam to grayish-brown silty clay. Below this layer the soil is similar to that described for the Crete series.

Included in areas mapped as this soil are small areas of Crete silt loam, 1 to 3 percent slopes; Crete silty clay loam, 3 to 7 percent slopes; and Geary-Crete silty clay loams, 3 to 7 percent slopes, severely eroded. Also included in places are small areas of Hastings silty clay loam, 3 to 7 percent slopes, eroded.

Most of this soil is cultivated, but a small acreage has been seeded to tame or native grasses. Capability unit IIIe–1 (dryland), IIIe–5 (irrigated); Clay Upland range site; windbreak suitability group 3.

Crete silty clay loam, 3 to 7 percent slopes (Ch) occurs throughout the county. This soil has thinner layers than the soil described for the Crete series and is not so deeply weathered. The dark-colored surface layer ranges from 6 to 12 inches in thickness. The subsoil ranges from grayish brown to brown. The surface layer and the subsoil combined range from 24 to 40 inches in thickness. On slopes of more than 4 percent, the subsoil is less dense than that in more gently sloping areas. Depth to concretions of lime ranges from 24 to 36 inches. Surface runoff is medium.

Included in areas mapped as this soil are small areas of Crete silt loam, 1 to 3 percent slopes; Crete silty clay loam, 2 to 5 percent slopes, eroded; Hastings silt loam, 3 to 7 percent slopes; and Hastings silty clay loam, 3 to 7 percent slopes, eroded.

Most of this soil is in native grass. Capability unit IIIe–4 (dryland), IIIe–5 (irrigated); Clay Upland range site; windbreak suitability group 3.

Detroit Series

The Detroit series consists of deep, moderately well drained soils that have a loamy surface layer underlain by a loamy to clayey subsoil. These soils developed in weakly stratified alluvial deposits of silt and clay. They occur in slight depressions on the terraces, or second bottoms, in the valley of the Republican River.

The surface layer is silty clay loam that is neutral and is about 12 inches thick. It is easily worked when slightly dry or moist. The plow layer is dark grayish brown, is sticky when wet, and contains hard clods when dry. The subsurface layer is granular in structure and dark gray in color.

The subsoil is about 24 inches thick. The upper part is dark-gray silty clay loam that has fine subangular blocky structure and is hard when dry and plastic when wet. The lower part is gray and consists of silty clay or stratified silty clay and silty clay loam that is spotted with dark brown. The lower part has medium blocky structure and is extremely hard when dry and plastic when wet. Both parts of the subsoil are neutral.

Underlying the subsoil is light brownish-gray silty clay loam that is distinctly spotted and streaked with

dark brown. This layer is very hard when dry and plastic when wet. It is weakly calcareous and contains a few, small, hard concretions of lime.

The Detroit soils have slow runoff and are temporarily ponded in some areas. Internal drainage is medium, and permeability is moderately slow.

Detroit silty clay loam (0 to 1 percent slopes) (Dt) occurs with Muir soils in various-sized depressions. Small areas of Muir silt loam, 0 to 1 percent slopes, are included in areas mapped as Detroit silty clay loam.

Detroit silty clay loam generally is used as cropland, but a small acreage remains in native grass. Other suitable uses are windbreaks and wildlife areas. All of the commonly grown crops in the county are suited to this soil. Under dryland farming, wheat is particularly well suited. Because surface water is excessive in wet years, yields of all crops may be lowered. This soil is suitable for irrigation, and some areas are irrigated. Capability unit IIs–1 (dryland), I–2 (irrigated); Loamy Lowland range site; windbreak suitability group 1.

Englund Series

The Englund series consists of moderately sloping, deep, moderately well drained soils that developed from clayey shale of the Dakota formation. These soils occur in the southeastern part of the county.

The gray surface layer is granular, slightly acid silty clay loam about 12 inches thick. It is hard when dry and sticky when wet.

The subsoil is about 24 inches thick. The upper part is gray silty clay that has fine angular blocky structure. The lower part is grayish-brown silty clay loam that is marked with streaks and spots of dark brown and has medium angular blocky structure. Both parts of the subsoil are neutral and are very hard when dry and plastic when wet. Limy concretions are scattered throughout the lower part.

Beneath the subsoil is light-gray silty clay loam that is distinctly marked with streaks and spots of dark brown and yellowish brown. This layer is hard when dry and sticky when wet. Numerous, soft and hard concretions of lime occur in this layer. It is 2 to 3 feet thick and grades into weathered shale.

The Englund soils have medium runoff and internal drainage. Permeability is moderately slow, and moisture-holding capacity is good. Natural fertility is moderate. Cultivated areas are susceptible to water erosion.

Englund silty clay loam, 3 to 7 percent slopes (Ea).—This soil developed over clay shale and is as little as 2 feet thick in places. In some areas there are a few concretions of lime above the weathered shale.

Included in areas mapped as this soil are small areas of Crete silty clay loam, 3 to 7 percent slopes; and Lancaster loam, 4 to 8 percent slopes.

Most of this Englund silty clay loam is in native grass. The small acreage that is cultivated is moderately productive of the crops commonly grown in the county. This soil also can be used for windbreaks and wildlife areas as needed. Capability unit IIIe–4 (dryland); Clay Upland range site; windbreak suitability group 3.

Eudora Series

The Eudora series consists of deep, well-drained soils that have a loamy surface layer and subsoil. These soils developed in alluvial deposits that overlie an old soil having silt loam or clay loam texture. Eudora soils occur in the valley of the Republican River on gently undulating and moderately sloping terraces, or second bottoms.

The surface layer is grayish-brown, very friable loam that is easily worked within a wide range of moisture content. The subsurface layer is thin and consists of grayish-brown, soft loam that has weak granular structure. Both of these layers are neutral. Their combined thickness is about 10 inches.

The subsoil, about 10 inches thick, is mixed grayish-brown and light-gray, friable loam that is neutral and has weak granular structure. It gradually becomes lighter colored as it grades to the underlying material.

Underlying the subsoil is light-gray loam, fine sandy loam, or stratified loam and fine sandy loam that ranges from 16 to 24 inches in thickness. This material is very friable and neutral to calcareous. In some places, streaks of soft lime are in the lower part.

At a depth below 36 inches is the surface layer of an older soil. This layer is dark grayish-brown, friable silt loam or clay loam that has moderate granular structure. It is streaked and spotted with whitish, soft concretions of lime.

The Eudora soils have medium internal drainage and slow runoff. Permeability is moderate, and moisture-holding capacity is good to moderate. These soils are highly productive but are generally susceptible to wind erosion and to slight water erosion.

Eudora loam, 0 to 2 percent slopes (Ed).—This soil is like the soil described as typical for the series. The surface layer ranges from dark grayish brown to grayish brown in color and from 8 to 12 inches in thickness. Depth to the dark-colored substratum ranges from 40 to 50 inches.

Included in areas mapped as this soil are small areas that have a light brownish-gray loamy fine sand surface layer. Also included are small areas of Muir silt loam.

This Eudora loam is well suited to the crops commonly grown in the county and to truck crops and native grasses. It can be used for trees in windbreaks and as wildlife habitat. Water erosion is not a problem, but in some fields wind erosion is serious during droughts. Wind erosion can be reduced by stubble mulching and arranging crop rows so that they resist the effects of wind. Capability unit I–1 (dryland), I–2 (irrigated); Loamy Lowland range site; windbreak suitability group 1.

Eudora loam, 2 to 8 percent slopes (Eu) occurs on the escarpments between terraces in the valley of the Republican River. The surface layer and subsoil range from dark grayish brown to light brownish gray. These layers combined are only 6 to 14 inches thick and are thinner than the combined surface layer and subsoil of Eudora loam, 0 to 2 percent slopes. In some places the surface layer is light brownish gray.

Included on the lower parts of slopes are outcrops of light grayish-brown fine sandy loam and dark grayish-brown silt loam or clay loam. Also included are a few

small areas of Muir silt loam, 3 to 7 percent slopes, eroded.

This Eudora soil is suited to the crops commonly grown in the county, to native grasses, and to trees in windbreaks. Some places can be used as wildlife areas. The hazard of soil and water loss is great enough to restrict use of row crops. If special practices are used, this soil is suitable for irrigation. Capability unit IIIe–3 (dryland), IIIe–6 (irrigated); Loamy Lowland range site; windbreak suitability group 1.

Geary Series

The Geary series consists of deep, well-drained soils that have a loamy surface layer and a moderately fine textured subsoil. These soils developed on brownish loess and similar silty material. They occur in the rolling uplands on moderate slopes below the ridge tops.

These soils have a dark-colored or brownish, friable, loamy surface layer 6 to 10 inches thick. This layer is easily worked when it is slightly moist, but it is sticky when it is wet. The surface layer is slightly acid to neutral.

The subsoil, about 36 inches thick, is made up of three parts. The upper part is strong-brown, friable silty clay loam that has fine subangular blocky structure. The middle part is reddish-yellow silty clay loam that has angular blocky structure and contains more clay than the upper or lower part. The lower part of the subsoil is light-brown to light reddish-brown silty clay loam that has subangular blocky structure and contains limy concretions. The subsoil is neutral.

Underlying the subsoil is light reddish-brown or pinkish silty clay loam or clay loam. This material is friable and neutral, and it contains a few medium to large, hard concretions of lime. In most places it is several feet thick, and in some places it overlies limestone and shale bedrock.

The Geary soils have medium internal drainage and runoff. Permeability is moderately slow, and moisture-holding capacity is good. These soils are moderately high in natural fertility but are susceptible to water erosion.

The Geary soils are well suited to all of the crops commonly grown in the county. They are also well suited to native grasses, to trees in windbreaks, and as wildlife areas. Most of the acreage is cultivated; yields are moderate to high. These soils are suitable for irrigation.

Geary-Crete silt loams, 3 to 7 percent slopes (Gc) occurs throughout the county. These soils are well drained. Geary silt loam makes up about 65 percent of this complex; Crete silt loam, about 20 percent; and Hastings silt loam, about 15 percent. These soils were mapped as a complex because they are so intermingled that they could not be shown separately on a map of the scale used.

The Geary silt loam is similar to the Geary soil described for the series. Its surface layer is dark-colored silt loam 10 to 14 inches thick. In some places fine gravel is scattered throughout the profile. Included in some places are small areas that have a clay loam surface layer and a clay loam to sandy clay loam subsoil that is underlain by sandy clay loam to loam soil material. In areas that are noticeably sandy or gravelly the surface layer and subsoil combined are about 40 inches thick.

The Crete silt loam in this complex is like the Crete soil described for the Crete series. The Hastings silt loam is like the Hastings soil described for the Hastings series.

Included in mapped areas of this complex are small areas of Geary-Crete silty clay loams, 3 to 7 percent slopes, severely eroded; Hobbs silt loam; and Kipson soils, 11 to 30 percent slopes.

The soils in this complex have medium internal drainage and runoff. Permeability is moderately slow, and moisture-holding capacity is good.

This complex is almost entirely in native grass range, but it is suited to the crops commonly grown in the county and to windbreaks and wildlife areas. It is also suitable for irrigation. Conservation practices are needed for reducing losses of water and soil. Both soils of the complex, capability unit IIIe–4 (dryland) and IIIe–5 (irrigated); windbreak suitability group 3. Crete soil: Clay Upland range site. Geary soil: Loamy Upland range site.

Geary-Crete silty clay loams, 3 to 7 percent slopes, severely eroded (Gr) are mainly in the northern part of the county. Geary silty clay loam makes up about 70 percent of this complex; Crete soils, about 20 percent; and Hastings soils, about 10 percent. These soils are mapped as a complex because they are so intermingled that they could not be shown separately on a map of the scale used.

Except for the surface layer, the Geary silty clay loam is like the soil described for the series. It has lost all of the original dark-colored surface soil, and its present surface layer ranges from grayish brown or brown to reddish brown and from silty clay loam to clay loam. Spots of light reddish-brown to pinkish clay loam occur in some areas, and in other areas there are spots of light reddish-brown loam. Gravel is scattered on the surface and throughout the soil is some places. Underlying the subsoil is reddish-brown, plastic silty clay loam or friable clay loam.

The Hastings and Crete soils in this complex are similar to the soils described in the mapping unit Hastings and Crete soils, 3 to 7 percent slopes, severely eroded.

Included in some areas mapped as this complex are small areas of Geary-Crete silt loams, 3 to 7 percent slopes; Hobbs silt loam; and Kipson soils, 11 to 30 percent slopes. Also included are a few areas that have a surface layer and subsoil of brown clay loam and underlying material of sandy clay loam or loam. Most of these areas contain fine gravel throughout the profile. The surface layer and subsoil combined range from 30 to 40 inches in thickness.

Most of these Geary-Crete silty clay loams are cultivated, but some of the acreage is seeded to tame grass. These soils are suitable for all of the crops commonly grown in the county; yields are fair to moderate. Native grass range, windbreaks, and wildlife areas are other suitable uses. Also suitable is irrigation. Conservation practices are needed to reduce the erosion hazard and to help maintain or increase crop yields. Both soils of this complex: Capability unit IVe–1 (dryland) and IVe–4 (irrigated); windbreak suitability group 3. Geary soil: Loamy Upland range site. Crete soil: Clay Upland range site.

Hastings Series

The Hastings series consists of deep-well-drained, loamy soils that developed in loess. These soils occur on the nearly level to rolling uplands.

Most Hastings soils have a dark-colored surface layer of silt loam, silty clay loam, or fine sandy loam. This layer is granular, slightly acid, and about 12 inches thick. The plow layer is easy to work when moist, and it is slightly sticky when wet. The subsurface layer is mellow and grades gradually to the subsoil.

The subsoil is silty clay loam about 40 inches thick. In the upper part the subsoil is dark grayish brown, is friable, and has fine subangular blocky structure. The middle part is grayish brown or brown and has angular blocky structure. It contains more clay than the upper or lower part and is very hard when dry and sticky when wet. The lower part is light brownish gray or grayish brown and has subangular blocky structure. The upper and middle parts of the subsoil are slightly acid, but the lower part is neutral. The lower part contains some small, hard concretions of lime.

The underlying material is friable, grayish-brown or pale-brown silty clay loam that grades to calcareous silt loam below a depth of 4 feet. In places this layer is moderately marked with strong-brown spots and streaks. It contains soft and hard concretions of lime.

The Hastings soils have slow to rapid runoff and medium internal drainage. Permeability is moderately slow, and moisture-holding capacity is good. Natural fertility is high, but these soils generally are susceptible to water erosion.

These soils are well suited to all of the crops commonly grown in the county, and to native grass, to trees in windbreaks, and as wildlife areas. Most of the acreage of these soils is cultivated and produces moderate to high yields. These soils are suitable for irrigation.

Hastings silt loam, 0 to 1 percent slopes (Ha) occurs mainly in the northwestern and north-central parts of the county. This soil is well drained. It has a slightly thicker surface layer than the soil described for the series and has more clay in the middle part of the subsoil. Also, mottling is more distinct in the underlying material, and the depth to the calcareous material is greater.

Included in areas mapped as this soil are small areas of Hastings silt loam, 1 to 3 percent slopes; of Crete silt loam, 0 to 1 percent slopes, in small depressions; of Crete silt loam, 1 to 3 percent slopes; and of Butler silt loam, thin surface variant.

This Hastings silt loam has slow runoff and medium internal drainage. Permeability is moderately slow, and moisture-holding capacity is good. Loss of soil from erosion is minor, but runoff can reduce the amount of water available to plants and limit crop production.

Nearly all the acreage of Hastings silt loam is cultivated, and practically all the acreage available for cultivation in the Bostwick Irrigation District is irrigated. This soil is well suited to all the crops commonly grown, some special crops, and native grass. Capability unit I–1 (dryland), I–2 (irrigated); Loamy Upland range site; windbreak suitability group 3.

Hastings silt loam, 1 to 3 percent slopes (Hb) occurs throughout the county. This soil is well drained. Its surface layer ranges from 10 to 14 inches in thickness and is easily worked. The subsoil is generally heavy silty clay loam, but it is friable and easily penetrated by plant roots.

Included in areas mapped as this soil are areas of Hastings silt loam, 0 to 1 percent slopes; Hastings silt loam, 3 to 7 percent slopes; and Crete silt loam, 1 to 3 percent slopes.

This Hastings silt loam has medium internal drainage and slow runoff. Permeability is moderately slow, and moisture-holding capacity is good. Conservation practices are needed to help reduce losses of water and soil and to help maintain productivity.

This soil is well suited to corn and can be used for irrigated crops. Windbreaks and wildlife areas are also suitable uses. Most of this soil is cultivated, but much of it remains in native grass. Capability unit IIe–2; (dryland), IIe–3 (irrigated); Loamy Upland range site; windbreak suitability group 3.

Hastings silt loam, 3 to 7 percent slopes (Hc) occurs throughout the county. This soil is well drained. It has thinner and more poorly developed layers than the Hastings silt loams on more gentle slopes. The surface layer ranges from 6 to 12 inches in thickness. The subsoil is only 30 to 36 inches thick and is generally browner and contains less clay than that of the less sloping Hastings silt loams. This soil has fewer soft and hard concretions of lime than Hastings silt loam, 1 to 3 percent slopes, and less noticeable mottling.

Included in areas mapped as this soil are small areas of Hastings silt loam, 1 to 3 percent slopes; Hastings silty clay loam, 3 to 7 percent slopes, eroded; Crete silty clay loam, 3 to 7 percent slopes; and Geary silt loam, 3 to 7 percent slopes.

This Hastings soil has medium internal drainage and runoff. Permeability is moderately slow, and moisture-holding capacity is good.

This soil is used mainly as native grass range. It is suitable for the crops commonly grown in the county and for windbreaks and wildlife areas. It is also suitable for irrigation. In cultivated fields conservation practices are needed for reducing loss of soil and water and for helping to maintain production. Capability unit IIIe–4 (dryland), IIIe–5 (irrigated); Loamy Upland range site; windbreak suitability group 3.

Hastings silty clay loam, 3 to 7 percent slopes, eroded (Hd) occurs throughout the county. This soil is well drained. It is steeper and more eroded than the soil described for the series. Nearly all of the original dark-colored surface layer has been lost through erosion, and the present surface layer is made up of 2 to 3 inches of the original surface layer and part of the upper subsoil. The surface layer is grayish-brown to brown silty clay loam that is friable when moist but sticky when wet and cloddy when dry. The clods are hard and of various sizes. The other layers of this soil are like corresponding layers in the Hastings soil described for the series. Shallow gullies have formed in most places, and one or more deep gullies have formed in a few places.

Included in areas mapped as this soil are small areas of Hastings silt loam, 3 to 7 percent slopes; Hastings and Crete soils, 3 to 7 percent slopes, severely eroded; Hastings silt loam, 1 to 3 percent slopes; Crete silty clay loam, 2 to 5 percent slopes, eroded; and Geary silty clay loam, 3 to 7 percent slopes, severely eroded.

This soil has medium internal drainage and medium to rapid runoff. Permeability is moderately slow, and moisture-holding capacity is good.

This soil is used mainly as cropland. It is suitable for native grass, windbreaks, and wildlife areas. It is also suitable for irrigation. Conservation practices are needed to reduce losses of soil and water and to help maintain crop yields. Capability unit IIIe–1 (dryland), IIIe–5 (irrigated); Loamy Upland range site; windbreak suitability group 3.

Hastings and Crete soils, 3 to 7 percent slopes, severely eroded (He) occur throughout the county. These soils are well drained. They are in narrow, scattered areas on slopes that steepen near the base. The two soils are so intermingled that they could not be shown separately on a map of the scale used. All of the surface layer and some of the subsoil have been removed through erosion. Shallow gullies are in many areas, and one or more deep gullies are in a few areas.

The surface layer of the Hastings soil is generally gray to grayish-brown silty clay loam, but there are small areas of gray silt loam. This layer is sticky when wet and is loose to cloddy when dry. In many places the plow layer overlies grayish weathered material and contains small, hard concretions of lime. The subsoil is grayish-brown or brown silty clay loam that has subangular blocky structure and grades to the underlying grayish silty material.

The surface layer of the Crete soil is grayish-brown to gray silty clay or silty clay loam. Small, gray spots of silt loam occur in many places. In most places the surface layer contains small, hard concretions of lime. The subsoil, 6 to 10 inches thick, is grayish-brown or gray silty clay or silty clay loam. It grades gradually to the gray, silty underlying material. In some areas the plow layer directly overlies the gray, silty material.

Included in areas mapped as these soils are small areas of Hastings silty clay loam, 3 to 7 percent slopes, eroded; Crete silty clay loam, 2 to 5 percent slopes, eroded; and Geary-Crete silty clay loams, 3 to 7 percent slopes, severely eroded.

Hastings and Crete soils, 3 to 7 percent slopes, severely eroded, have medium internal drainage and rapid surface drainage. Permeability is moderately slow, and moisture-holding capacity is fair to good.

These soils are used as cropland; yields are fair to moderate. Suitable uses are native grass range, windbreaks, and wildlife areas. Also, these soils are suitable for irrigation. Conservation practices are needed to help maintain or increase crop yields. Capability unit IVe–1 (dryland), IVe–4 (irrigated). Hastings soil: Loamy Upland range site; windbreak suitability group 3. Crete soil: Clay Upland range site; windbreak suitability group 3.

Hastings-Ortello fine sandy loams, 1 to 4 percent slopes, eroded (Hf).—In this county these soils occur only northeast of the town of Republic on the watershed of Otter (Sandy) Creek. These soils are well drained. Hastings fine sandy loam makes up about 65 percent of the mapping unit, and Ortello fine sandy loam makes up about 15 percent. Soils having some characteristics of both soils make up the remaining 20 percent. In some mapped areas are small areas of Crete soils.

Hastings fine sandy loam is somewhat similar to the soil described for the Hastings series, but it has a fine sandy loam, medium acid surface layer 6 to 18 inches thick. Also, the upper subsoil is clay loam, generally 8 to 12 inches thick, but in places almost all of the subsoil is clay loam. Beneath the clay loam is silty clay loam and varying amounts of small, hard concretions of lime.

The surface layer of the soils having some characteristics of both Hastings and Ortello fine sandy loams is gray to dark-gray fine sandy loam 6 to 24 inches thick. This layer is medium acid, loose when dry, and easily worked. In most places the subsoil is grayish-brown or yellowish-brown sandy loam 12 to 24 inches thick, but in other areas it is brown sandy loam or sandy clay loam 10 to 20 inches thick. It is friable and slightly acid to neutral. In some places the subsoil contains hard concretions of lime in the lower part. The underlying material generally ranges from grayish-brown to brown clay loam or silty clay, but it is brown or light reddish-brown sandy clay loam or sandy clay in some places. This material is neutral and has hard concretions of lime scattered throughout.

The soils in this complex have medium to rapid runoff and internal drainage. Permeability ranges from moderately slow to moderate, and moisture-holding capacity is fair to good.

These soils are moderately productive and are suited to all of the crops commonly grown in the county. Native grass range, windbreaks, and wildlife areas are suitable uses. Also suitable is irrigation. These soils are better suited to grain sorghum than to corn. Cropped areas of these soils are susceptible to water and wind erosion, and conservation practices are needed to reduce erosion and to help maintain or improve crop yields. Both soils of the complex, capability unit IIIe–1 (dryland), IIIe–5 (irrigated); Sandy range site; windbreak suitability group 3.

Hastings-Ortello fine sandy loams, 4 to 8 percent slopes, eroded (Ho).—This mapping unit occurs with Hastings-Ortello fine sandy loams, 1 to 4 percent slopes, eroded. Hastings fine sandy loam makes up about 60 percent of the unit; Ortello fine sandy loam, about 20 percent; and soils having some characteristics of both soils, about 20 percent. Included in some areas mapped as this complex are small areas of other Hastings soils.

The Hastings fine sandy loam and the soil having some characteristics of both the Hastings and the Ortello soils are described under Hastings-Ortello fine sandy loams, 1 to 4 percent slopes, eroded. Ortello fine sandy loam is described under the Ortello series. Both soils of the complex, capability unit IIIe–1 (dryland) and IIIe–5 (irrigated); Sandy range site; windbreak suitability group 3.

Hastings soils, eroded-Hobbs complex (Hp) occurs along upland drainageways and small, intermittent streams throughout the county. It is made up of soils on narrow, nearly level bottom lands and of deep soils on adjoining side slopes having gradients of 4 to 8 percent. These soils were mapped as a complex because they are so intermingled that they could not be shown separately on a map of the scale used. Hastings soils make up about 50 percent of this complex; Hobbs soils, about 25 percent; and soils having a brownish surface layer and subsoil, about 10

percent. The rest of the complex consists of grayish soils that have a thin silty clay subsoil.

Cultivated areas of the soils on uplands are moderately to severely eroded and have thin, weekly developed layers. Even in areas in native grass, soil layers are thin and weekly developed. In cultivated areas, the Hastings soil is similar to Hastings soil in Hastings and Crete soils, 3 to 7 percent slopes, severely eroded. In areas in native grass, the Hastings soil is similar to Hastings silt loam, 3 to 7 percent slopes, but has a silty clay loam surface layer and a much thinner surface layer and subsoil. Also, calcareous silt loam is much nearer the surface.

The Hobbs soil is similar to the soil described for the Hobbs series. In some cultivated areas, however, there are recent deposits of grayish-brown silty clay loam that may or may not contain gravel. These deposits are calcareous in places.

The soils that have a brownish surface layer and subsoil are silty clay loam or clay loam in both layers. In most areas, the underlying material is pinkish and ranges from silty clay loam to sandy clay loam. It is calcareous at a depth of 36 to 48 inches. In some places in the southern half of the county, the underlying material is reddish-brown silty clay loam. In places it is calcareous at a depth of 36 to 48 inches. In cultivated areas, these soils are eroded and have a surface layer of brown to reddish-brown silty clay loam or clay loam. In areas of native grass, the surface layer is dark brown.

The grayish soils have a silty clay loam surface layer and a thin silty clay subsoil. They contain limy concretions within about 18 to 24 inches of the surface. The grayish underlying material is calcareous at a depth of about 24 to 36 inches. In areas in native grass, the surface layer is dark grayish-brown silty clay loam, but in cultivated areas, this soil is eroded and has a surface layer of grayish silty clay loam, silty clay, or silt loam. Some areas have limy concretions on the surface.

The soils in this complex are well drained on uplands and moderately well drained on bottom lands. Permeability is slow to moderately slow, and moisture-holding capacity is good. The bottom lands are subject to temporary flooding.

The soils in this complex are suitable for all the crops commonly grown, and they can be used as rangeland, windbreaks, and wildlife areas. Conservation practices are needed for reducing losses of water and soil. During droughts most of the crop production is from the soils on bottom lands. Areas of the bottom land that are wide enough and are not seriously damaged by floods are suitable for row crops. Hastings soil: Capability unit IVe–1 (dryland), IVe–4 (irrigated); Loamy Upland range site; windbreak suitability group 3. Hobbs soil: Capability unit IIw–1 (dryland), IIw–2 (irrigated); Loamy Lowland range site; windbreak suitability group 1.

Hedville Series

The Hedville series consists of shallow, excessively drained, loamy soils that developed on weathered sandstone and sandy shale. These soils occur in the southeastern part of the county.

The surface layer, about 10 inches thick, is grayish-brown, medium acid loam that has fine granular structure. It grades gradually to dark grayish-brown material consisting of loam and weathered fragments of sandstone and sandy shale. This layer is loose, slightly acid, and about 5 inches thick. It is underlain by slightly weathered sandstone and sandy shale.

Nearly all of the acreage is used as native grass range. In this county the Hedville soils are mapped only in complex with the Lancaster soils.

Hobbs Series

The Hobbs series consists of moderately well drained, noncalcareous soils. These nearly level soils occur in the small valleys throughout the county.

The surface layer is dark-colored, mellow silt loam that is easily worked when the soil is slightly moist. It is granular, slightly acid, and about 20 inches thick.

The subsoil is gray, granular silty clay loam that is about 30 inches thick and contains thin layers of silt loam. This layer is slightly acid to neutral.

Underlying the subsoil is grayish-brown, very firm silty clay loam that is faintly mottled with dark brown. This layer is neutral.

These soils have medium internal drainage and runoff. They are high in natural fertility but are subject to frequent flooding.

Moderate management of rangeland helps to keep the range in good to excellent condition. In addition to range, these soils are suitable for cultivation and can be used as windbreaks or woodlots and as wildlife areas.

Hobbs silt loam (0 to 2 percent slopes) (Hs) occurs on the bottom lands of local stream valleys. Included in areas mapped as this soil are small areas of Muir silt loam, 0 to 1 percent slopes.

Hobbs silt loam is used as cropland and rangeland. In cultivated areas, yields of corn, grain sorghum, silage, and small grains are high. This soil can also be used as windbreaks and wildlife areas. It is suitable for irrigation. Capability unit IIw–1 (dryland), IIw–2 (irrigated); Loamy Lowland range site; windbreak suitability group 1.

Humbarger Series

The Humbarger series consists of well drained or moderately well drained, calcareous, loamy soils. The loamy layers overlie calcareous sand or sand and gravel. These soils occur on the nearly level to gently undulating flood plains of the Republican River.

The surface layer is grayish brown and about 7 to 10 inches thick. It is easily worked when moist but is sticky when wet.

The upper part of the subsoil is about 20 inches thick. It is generally gray silt loam, silty clay loam, or clay loam, but in some areas it is stratified, and texture generally ranges from silt loam to silty clay loam. This layer has granular structure. The lower part of the subsoil is light brownish-gray, friable, calcareous silt loam or clay loam. In most places it is faintly streaked with brown and yellowish brown. In many places this layer contains strata of sandy loam or loamy sand. It is about 15 to 20 inches thick and is often underlain by loose sand or sand and gravel.

These soils have slow runoff and medium to slow internal drainage. Permeability is moderately slow to

slow, and water-holding capacity is moderate to good. These soils are subject to flooding by the Republican River.

These soils are highly productive of the crops commonly grown in the county. They are used mainly for corn and grain sorghum. Cropping is not restricted by the water table, which fluctuates between depths of 3 and 10 feet. These soils are also suitable for native grass, windbreaks, and wildlife areas. They are suited to irrigation.

Humbarger clay loam (0 to 2 percent slopes) (Ht).—This soil is like the soil described as typical for the series, but it developed from moderately fine textured deposits. The surface layer is friable clay loam that is hard when dry and sticky when wet. The upper part of the subsoil is silty clay loam or clay loam that is hard when dry and plastic when wet. The lower part of the subsoil is silt loam or clay loam that overlies loose sand or sand and gravel.

The surface layer and subsoil combined range from 30 to 60 inches in thickness. The subsoil ranges from silty clay loam to clay loam.

Included in areas mapped as this soil are small areas of Humbarger loam, silt loam, and silty clay loam. Also included are small areas of Carr fine sandy loam. Other included areas are similar to Humbarger clay loam except that these inclusions are 20 to 30 inches to sandy strata.

Humbarger clay loam has slow runoff and internal drainage. This soil generally occurs in slight depressions, and it may be temporarily ponded after heavy rains. Permeability is slow, and moisture-holding capacity is good.

This soil is moderately to highly productive of all of the crops commonly grown in the county. It is used mainly for corn and grain sorghum, but it is better suited to corn than to grain sorghum. In some areas productivity can be increased by digging drainage ditches. This soil is suitable for native grass, windbreaks, and wildlife areas. It can be irrigated, but the depth to loose sand should be determined before any leveling is begun. Capability unit IIIw–1 (dryland), IIw–2 (irrigated); Loamy Lowland range site; windbreak suitability group 1.

Humbarger loam (0 to 2 percent slopes) (Hu).—This soil is similar to the soil described as typical for the series, but it developed from medium-textured deposits. The surface layer consists of mellow loam that is easily worked. The upper part of the subsoil is friable silt loam or light clay loam. It is generally silt loam in areas that are stratified. The upper subsoil is slightly hard when dry and sticky when wet. The lower subsoil is silt loam that is stratified with fine sandy loam. It overlies loose sand or sand and gravel.

The surface layer ranges from light brownish gray to dark grayish brown in color and from loam to silt loam in texture. The upper part of the subsoil ranges from light silt loam to light silty clay loam or clay loam. The surface layer and subsoil combined range from 30 to 60 inches in thickness.

Included in areas mapped as this soil are small areas that have a surface layer of fine sandy loam. Also included is a soil that is similar to Humbarger loam except that it is 20 to 30 inches to sandy strata.

Humbarger loam has slow surface drainage and medium internal drainage. Permeability is moderately slow, and moisture-holding capacity is moderate to good.

This soil is moderately to highly productive of all the crops commonly grown in the county. Additions of fertilizer help to maintain high yields of corn. Native grass, windbreaks, and wildlife areas are suitable uses. This soil is suitable for irrigation, but the depth to loose sand should be determined before leveling operations are started. Capability unit IIw–1 (dryland), IIw–2 (irrigated); Loamy Lowland range site; windbreak suitability group 1.

Kenesaw Series

The Kenesaw series consists of deep, well-drained and somewhat excessively drained, loamy soils that developed in thick loess. These moderately sloping soils occur in the hilly areas that border the valley of the Republican River.

The surface layer is dark grayish-brown, neutral, granular silt loam about 12 inches thick. It is easy to work when the soil is slightly moist, but it is sticky when it is wet. The surface layer grades gradually into the subsoil.

The subsoil consists of dark grayish-brown and pale-brown, soft silt loam that is neutral and has granular structure. The lower part of the subsoil is pale brown and grades gradually to the underlying material.

The upper part of the underlying material is pale-brown, soft silt loam about 20 inches thick. It contains scattered, soft concretions of lime in the lower 10 inches. The upper subsoil is neutral and has granular structure. The lower part of the underlying material is pale-brown, soft, massive silt loam that contains soft concretions of lime.

These soils have medium internal drainage and rapid runoff. Permeability is moderately slow to moderate, and moisture-holding capacity is good. Natural fertility is moderately high, but these soils are susceptible to water erosion.

These soils are suited to all of the crops commonly grown in the county and produce moderate yields. They are suitable for native grass range, windbreaks, and wildlife areas. These soils are also suitable for irrigation. About one-third of the acreage is in native grasses.

Kenesaw silt loam, 5 to 12 percent slopes (Ke) occurs in the hilly areas that border the valley of the Republican River. In the few cultivated areas, the surface layer is grayish-brown and ranges from 7 to 10 inches in thickness.

Included in areas mapped as this soil are small areas of Hastings silty clay loam, 3 to 7 percent slopes, eroded; and Kenesaw silt loam, 5 to 12 percent slopes, eroded.

Nearly all of the acreage of this soil is in native grass. Capability unit IVe–2 (dryland), IIIe–6 (irrigated); Loamy Upland range site; windbreak suitability group 3.

Kenesaw silt loam, 5 to 12 percent slopes, eroded (Kn) occurs in the hilly areas that border the valley of the Republican River. Most of the original surface layer has been removed through erosion. Shallow gullies are in some areas, and deep gullies are in a few areas. Soft concretions of lime occur on the surface at the lower part of some slopes.

The surface layer of this soil is loose silt loam that is neutral and about 6 inches thick. It ranges from gray to grayish brown. This layer is easy to work when moist, but it is sticky when wet. The subsoil is pale-brown to grayish-brown, soft, neutral silt loam that is spotted and streaked with brown and yellow in a few places.

Included in areas mapped as this soil are small areas of Kenesaw silt loam, 5 to 12 percent slopes; and Hastings and Crete soils, 3 to 7 percent slopes, severely eroded.

Most of this soil is cultivated. The crops are those commonly grown in the county. Yields are fair to moderate. Conservation practices are needed to help maintain or to increase yields and to reduce losses of water and soil. Capability unit IVe–2 (dryland), IIIe–6 (irrigated); Loamy Upland range site; windbreak suitability group 3.

Kipson Series

The Kipson series consists of shallow, well-drained to excessively drained soils on moderate to steep slopes throughout the county. These soils have a dark-colored surface layer that gradually grades to partly weathered limestone and shale.

The surface layer, about 12 inches thick, is dark-gray, calcareous loam that has fine granular structure. The underlying material is a white mass consisting of soil and fragments of limestone and shale. The soil material ranges from loam to silty clay loam and is calcareous. This layer is about 10 inches thick and is underlain by limestone interbedded with shale.

These well-drained to excessively drained soils have medium internal drainage and medium to rapid surface drainage. Moisture-holding capacity is moderate to low.

Nearly all of the acreage of Kipson soils is in native grass. The range is good to excellent. Most of the cultivated acreage occurs as narrow strips at the edge of cultivated areas of deep soils.

Kipson soils, 11 to 30 percent slopes (Kp) occurs on moderately sloping hilltops and steep side slopes throughout the county; it is in large areas in the southern half. The cultivated areas have a grayish-brown to brown shaly loam surface layer and subsoil. In most places this soil is 12 to 18 inches thick over limestone or shale, but on some of the steeper slopes, there is only 6 to 8 inches of shaly loam over the partly weathered limestone and shale.

Included in some areas mapped as this soil are small areas of Lancaster-Hedville loams, 5 to 25 percent slopes. Also included in some narrow valleys are strips of Tully silty clay loam, 4 to 8 percent slopes, and Hobbs silt loam.

This soil is almost entirely in native grass. Capability unit VIe–1 (dryland); Breaks range site; windbreak suitability group 4.

Lancaster Series

The Lancaster series consists of moderately deep to deep, well-drained soils that have a loamy surface layer and a friable, loamy subsoil. These soils developed from sandstone and shale. They are on moderate slopes in the southeastern part of the county.

Lancaster loam has a gray, slightly acid surface layer that has granular structure. It is easily worked when slightly moist, but it is sticky when wet. The surface layer is about 10 inches thick and grades gradually into the subsoil.

The subsoil is about 30 inches thick. The upper part of the subsoil is brown to dark-brown clay loam that has granular structure. The lower part is yellowish-red clay loam that has well-developed subangular blocky structure and is hard when dry and sticky when wet. The lower 6 inches of the subsoil is lighter colored and contains less clay than the upper part. The upper part is slightly acid, but the lower part is neutral.

Underlying the subsoil is neutral, strong-brown or reddish-yellow, friable loam, about 12 inches thick. Weathered fragments of sandstone are numerous throughout this layer. This layer grades gradually to slightly weathered sandstone and shale below a depth of 4 feet.

The Lancaster soils have medium internal drainage and runoff. Permeability is moderately slow, and moisture-holding capacity is good.

These soils are suited to all of the crops commonly grown in the county and to native grass range, to trees in windbreaks, and as wildlife areas. Also, they are suitable for irrigation. Natural fertility is moderately high, but these soils are susceptible to water erosion.

Lancaster loam, 4 to 8 percent slopes (La) occurs in the southeastern part of the county. This soil is like the soil described for the series, but the lower part of the subsoil is clay loam that contains a few, small hard concretions of lime. In some places flat sandstone pebbles or stones are on the surface or throughout the profile. Depth to the underlying sandstone and shale ranges from 48 to 60 inches or more.

Included in areas mapped as this soil are small areas of Lancaster loam, 4 to 8 percent slopes, eroded; Hastings silt loam, 3 to 7 percent slopes; Crete silty clay loam, 3 to 7 percent slopes; Tully silty clay loam, 4 to 8 percent slopes; and Lancaster-Hedville loams, 5 to 25 percent slopes. Also included are small spots that are influenced by a thin deposit of loess. These areas have a silt loam surface layer and a dark-brown silty clay loam upper subsoil.

This Lancaster loam has medium runoff and internal drainage. Permeability is moderately slow, and moisture-holding capacity is good.

Nearly all of this soil is in native grass range. It is suited to all of the crops commonly grown in the county, to trees in windbreaks, and as wildlife areas. Also, it is suitable for irrigation. In cultivated areas conservation practices and adequate additions of fertilizer are needed. Capability unit IIIe–2 (dryland), IIIe–5 (irrigated); Loamy Upland range site; windbreak suitability group 3.

Lancaster loam, 4 to 8 percent slopes, eroded (Lc) occurs in the southeastern part of the county. It has lost nearly all of the original surface layer through erosion. The present surface layer ranges from grayish brown to reddish brown and may include small spots of yellowish red. It is hard when dry and slightly sticky or sticky when wet. In some places pebbles of weathered sandstone are on the surface or scattered throughout the profile. Gullies, a few of them deep, have formed. Depth to the underlying sandstone and shale ranges from 40 to 60 inches.

Included in areas mapped as this soil are small areas of Lancaster loam, 4 to 8 percent slopes; Hastings silty clay loam, 3 to 7 percent slopes, eroded; Crete silty clay loam, 2 to 5 percent slopes, eroded; and Tully silty clay loam, 4 to 8 percent slopes, eroded. Also included are areas of Lancaster soil that are influenced by loess. These areas have a surface layer that ranges from silt loam to silty clay loam and a subsoil that is grayish-brown silty clay loam in the upper part.

This Lancaster loam has medium internal drainage and medium to rapid runoff. Permeability is moderately slow, and moisture-holding capacity is moderate to good.

Nearly all of the acreage of this soil is used as cropland. It is suitable for all the crops commonly grown in the county, for native grass, and for windbreaks and wildlife areas. Conservation practices are needed for reducing loss of water and soil and for helping to maintain or increase yields. All crops need to be fertilized; additions of phosphate and lime are especially needed. Capability unit IIIe–2 (dryland), IIIe–5 (irrigated); Loamy Upland range site; windbreak suitability group 3.

Lancaster-Hedville loams, 5 to 25 percent slopes (Lh) occur in the southeastern part of the county. Hedville loam makes up about 60 percent of the complex; Lancaster loam, about 35 percent; and Englund silty clay loam, about 5 percent. These well-drained or excessively drained soils are moderately deep or shallow over sandstone or shale.

The Hedville loam of this complex is like the soil described for the Hedville series. On slopes of less than 10 percent, the depth to sandstone and shale generally is about 15 inches but ranges from 20 to 24 inches. On slopes of more than 10 percent, this soil generally is only 5 to 10 inches thick.

The Lancaster loam is similar to the soil described for the Lancaster series, but the surface layer ranges from loam to stony loam in texture and from 5 to 10 inches in thickness. The subsoil generally is yellowish-red, subangular blocky clay loam 15 to 20 inches thick. The surface layer and subsoil combined average 30 inches in thickness. They are as thin as 20 inches or as deep as 40 inches. In some areas the surface layer is dark-brown loam; the subsoil is brown, granular loam; and bedrock is at a depth of 24 inches. In most places pieces of sandstone are on or beneath the surface layer, and bedrock crops out in a few places.

The Englund silty clay loam is similar to the soil described for the Englund series, but in this complex the depth to partly weathered clay shale is only 20 to 30 inches.

Included in areas mapped as these soils are small areas of Crete silt loam, 1 to 3 percent slopes; Lancaster loam, 4 to 8 percent slopes; Tully silty clay loam, 4 to 8 percent slopes; and Kipson soils, 11 to 30 percent slopes.

The soils in this complex are well drained or excessively drained; internal drainage and runoff are medium to rapid. Permeability is moderate to moderately slow, and moisture-holding capacity is fair to moderate.

These soils are suitable as native grass range, windbreaks, and wildlife areas. Nearly all of the acreage is used as native grass range. Both soils of complex, capability unit VIe–1 (dryland). Lancaster soil: Loamy Upland range site; windbreak suitability group 3. Hedville soil: Breaks range site; windbreak suitability group 4.

Muir Series

The Muir series consists of deep, well-drained, loamy soils that developed in alluvial deposits on the terraces, or second bottoms. These soils occur in the valley of the Republican River and in all local valleys that have second bottoms.

The surface layer is grayish-brown silt loam. This layer is easy to work. It is loose when dry and slightly sticky when wet. The subsurface layer is dark-gray, fine, granular silt loam that is soft when dry and slightly sticky when wet. The surface layer and subsurface layer are neutral. Their combined thickness is about 20 inches. The subsurface layer grades gradually to the subsoil.

The upper part of the subsoil is grayish-brown, granular silt loam to silty clay loam, and the lower part is grayish-brown, granular light silty clay loam. Both parts are neutral. Their combined thickness is about 20 inches. The subsoil gradually becomes lighter colored as depth increases, and it grades to the underlying material.

The underlying material is light brownish-gray, friable silt loam or loam. It is neutral and contains soft concretions of lime.

The Muir soils have medium internal drainage and slow to rapid runoff. Permeability is moderate, and moisture-holding capacity is good. These soils are susceptible to wind erosion during droughts.

These soils are highly productive, and they can be intensively cultivated to all of the crops commonly grown in the county. They are also suited to special crops, to native grasses, to trees in windbreaks, and as wildlife areas. Muir soils are suitable for irrigation.

Muir silt loam, 0 to 1 percent slopes (Mr) occurs in the valley of the Republican River and in nearly all of the local stream valleys.

In the valley of the Republican River, the surface layer ranges from silt loam to loam and the subsoil ranges from silt loam to silty clay loam. In the local valleys, the surface layer is silt loam and the subsoil is silty clay loam. Limy concretions are at a greater depth in the valley of the Republican River than they are in the local valleys.

Included in areas in the vicinity of Norway are small areas where the surface layer is loam and the substratum is loam to fine sandy loam. Also included with this soil, near the sides of valleys, are some areas that have gravel on the surface or in lenses beneath the surface layer. Other inclusions are small areas of Muir silt loam, 3 to 7 percent slopes, eroded; Eudora loam, 0 to 2 percent slopes; Detroit silty clay loam; and Hobbs silt loam.

This Muir silt loam has slow runoff and medium internal drainage. Permeability is moderate, and moisture-holding capacity is good.

This soil is suited to row crops, and they are intensively cultivated. High yields of corn and grain sorghum can be maintained on this soil if adequate fertilizer is added. Also suitable are other crops commonly grown in the county, some special crops, and native grass. Windbreaks and wildlife areas are also suitable uses. Loss of soil as a result of wind erosion during droughts may become a problem. This soil is suitable for irrigation. Capability unit I–1 (dryland), I–2 (irrigated);

Loamy Lowland range site; windbreak suitability group 1.

Muir silt loam, 3 to 7 percent slopes, eroded (Mu) occurs in the valley of the Republican River and in local stream valleys. This soil is well drained. The surface layer ranges from grayish brown to dark grayish brown in color and from 6 to 10 inches in thickness. The subsoil ranges from pale brown to dark grayish brown. It is generally silt loam, but in places it is silty clay loam that is 8 to 12 inches thick. In some areas, the grayish-brown surface layer overlies the grayish, soft silt loam soil material. A layer of dark grayish-brown clay loam or grayish fine sandy loam crops out in some areas near the base of slopes.

Included in areas mapped as this soil are small areas of Muir silt loam, 0 to 1 percent slopes; Eudora loam, 2 to 8 percent slopes; and Hobbs silt loam.

This Muir silt loam has medium internal drainage and rapid runoff. Permeability is moderate, and moisture-holding capacity is moderate.

This soil is suited to all the crops commonly grown in the county and to native grass. It can be used for windbreaks and for wildlife areas. Conservation practices are needed to reduce loss of water and soil and to help maintain or increase productivity. This soil is suitable for irrigation. Capability unit IIIe–3 (dryland), IIIe–6 (irrigated); Loamy Lowland range site; windbreak suitability group 1.

Ortello Series

The Ortello series consists of deep, gently to moderately sloping, well-drained soils that developed in sandy loam soil material in the uplands. In this county the Ortello soils occur only in the complex of Hastings-Ortello fine sandy loams in the Otter (Sandy) Creek watershed, which lies northeast of the town of Republic.

The surface layer is generally grayish-brown fine sandy loam about 10 inches thick. It is acid, mellow, and easily worked.

The upper part of the subsoil is fine sandy loam that is darkened with organic matter, and the lower part is yellowish-brown loam. Both layers are slightly acid and have weak granular to subangular blocky structure. The subsoil is about 24 inches thick.

Underlying the subsoil is brownish-yellow fine sandy loam 3 to 6 feet thick that is very friable, that is neutral, and that contains scattered concretions of lime.

These soils are suited to all crops commonly grown in the county and to native grass, to trees in windbreaks, and as wildlife areas. Most of the acreage is used as cropland. Cultivated areas are susceptible to water and wind erosion. These soils are suitable for irrigation.

Rough Broken Land

Rough broken land (Ro) is made up of deep, well-drained soils on narrow, isolated hilltops and steep, uneven side slopes. Parts of the bluffs along the edge of the valley of the Republican River are Rough broken land.

The surface layer is generally a dark grayish-brown, granular silt loam or silty clay loam. It is underlain by grayish-brown, brown, or reddish-brown, weathered silt loam or silty clay loam. Small spots of loam or gravelly loam occur in places. These loamy spots generally are underlain by brownish sandy loam to clay loam that contains varying amounts of fine gravel. In some areas there are spots of sand and gravel or narrow bands of shale or limestone.

This land has medium internal drainage and medium to rapid runoff. The moisture-holding capacity is good.

This land is suited only as range and is in native grass. Capability unit VIIe–1; Loamy Upland range site; windbreak suitability group 3.

Sarpy Series

The Sarpy series consists of well-drained and somewhat excessively drained, noncalcareous soils on bottom lands. These soils occur on gently undulating slopes and dunes in the valleys of the Republican River and Otter (Sandy) Creek.

The surface layer is grayish-brown, neutral, loose loamy fine sand about 7 inches thick. It is easy to work under a wide range of moisture content.

The subsoil, about 20 inches thick, is light brownish-gray, neutral to alkaline loamy fine sand. In places it contains thin layers of loam or silt loam, but the texture generally is loamy fine sand.

The underlying material is a light-gray loamy fine sand that is single grained and moderately calcareous. This layer is 2 to 3 feet thick and is underlain by stratified sand and gravel.

These soils have rapid internal drainage and medium to slow runoff. Permeability is moderate to moderately rapid, and moisture-holding capacity is low. These soils are subject to flooding by the Republican River.

Sarpy loamy fine sand (0 to 3 percent slopes) (Sa) is like the soil described for the series. This soil is calcareous at a depth that ranges from 15 to 36 inches.

Included in areas mapped as this soil are small areas of Carr fine sandy loam and Humbarger loam. Also included are areas of Sarpy soil that have a fine sand to fine sandy loam surface layer. In the northwestern corner of the county, the surface layer is fine sandy loam 10 inches thick and is underlain by sandy loam that grades to loose sand and gravel below a depth of 20 inches.

Most of the acreage of Sarpy loamy fine sand is cropped. All crops common in the county are grown. A small acreage is used for watermelons. Grain sorghum is better suited to this soil than is corn. Because this soil is subject to wind erosion during droughts, special practices are needed in some areas to control blowing. This soil is better suited to sprinkler irrigation than to gravity irrigation. Capability unit IIIw–2 (dryland), IIIw–4 (irrigated); Sandy Lowland range site; windbreak suitability group 2.

Sarpy soils, duned (Sd) occur on irregular dunes in the valley of the Republican River and along Otter (Sandy) Creek. These soils are less stratified than Sarpy loamy fine sand. They are excessively drained.

The surface layer ranges from dark grayish brown to light brownish gray and from loamy fine sand, or fine sand, to fine sandy loam. It ranges from 6 to 10 inches in thickness. The subsoil is grayish brown and loose. It ranges from loamy fine sand to loamy sand and is

6 to 10 inches thick. It is neutral and is slightly darkened with organic matter in the upper part. The underlying material is light-gray, stratified sand, loamy sand, and fine sand. The upper part of this layer is neutral, but below a depth of 3 feet the underlying material is calcareous.

Included in areas mapped as these soils are small areas of Sarpy loamy fine sand and Carr fine sandy loam.

Sarpy soils, duned, have rapid internal drainage and slow runoff. Moisture-holding capacity is low. These soils are suitable for native grass, but they can also be used for windbreaks and wildlife areas. Capability unit VIe–3; Sands range site; windbreak suitability group 2.

Tully Series

The Tully series consists of deep, well-drained, loamy soils. These soils developed from material washed from hills that are interbedded with limestone and shale and are capped with loess. They occur on gentle foot slopes in the hilly limestone areas in the southern half of the county.

The surface layer is very dark grayish-brown silty clay loam about 10 inches thick. It is granular and easily worked when slightly moist, but it is sticky when wet. This layer is slightly acid.

The subsoil is about 36 inches thick. Its upper part is dark-gray, granular silty clay loam, and its lower part is brown, firm silty clay loam. The subsoil is hard when dry and sticky when wet. It is neutral and, in the lower foot, contains hard concretions of lime.

The underlying material is brown or reddish-yellow, friable silt loam to silty clay loam. It is slightly alkaline and contains small, hard concretions of lime.

These soils have medium internal drainage and runoff. Permeability is moderately slow, and moisture-holding capacity is good.

Tully soils are well suited to the crops commonly grown in the county; yields are moderate to high. Other suitable uses are for native grass range, windbreaks, and wildlife areas. In cultivated areas conservation practices are needed for reducing loss of water and soil and for helping to maintain crop yields. These soils can be used for irrigated crops.

Tully silty clay loam, 4 to 8 percent slopes (Tu) occurs mainly in the southern half of the county. It is like the soil described for the series. The surface layer ranges from 10 to 14 inches in thickness. Near the base of the limestone hills, the upper part of the subsoil is calcareous and the soil contains some limestone gravel. In these areas the surface layer and subsoil combined are 36 to 40 inches thick, but away from the hills these layers are 48 inches thick or more.

Included with areas mapped as this soil are small areas of Tully silty clay loam, 4 to 8 percent slopes, eroded; Lancaster loam, 4 to 8 percent slopes; Kipson soils, 11 to 30 percent slopes; and Hobbs silt loam.

This soil has medium runoff and internal drainage. Permeability is moderately slow, and moisture-holding capacity is good.

Nearly all of this soil is in native grass. In many areas that are cut by lateral drains, use is limited to range. In other areas this soil is suited to the crops commonly grown in the county and can be used for windbreaks and wildlife areas. This soil is also suitable for irrigation. Conservation practices are needed for reducing loss of soil and water and for maintaining yields. Capability unit IIIe–4 (dryland), IIIe–5 (irrigated); Loamy Upland range site; windbreak suitability group 3.

Tully silty clay loam, 4 to 8 percent slopes, eroded (Ty) occurs in the southern half of the county. This soil is well drained. It has lost most of its original surface layer through erosion. The present surface layer is generally grayish brown or brown, but in a few places it is reddish brown. As this layer dries, hard clods form, but the soil is sticky when it is wet. Many areas have a few shallow gullies, and a few areas have one or more deep gullies.

Included with areas mapped as this soil are small areas of Tully silty clay loam, 4 to 8 percent slopes; Lancaster loam, 4 to 8 percent slopes, eroded; and Hobbs silt loam.

This soil has medium internal drainage and runoff. Permeability is moderately slow, and moisture-holding capacity is good.

Nearly all of this soil is cultivated, though lateral drains have cut into fields of various size. This soil is suitable for native grass, windbreaks, and wildlife areas. It can be irrigated. Conservation practices are needed for reducing loss of soil and water and for maintaining crop yields. Capability unit IIIe–1 (dryland), IIIe–5 (irrigated); Loamy Upland range site; windbreak suitability group 3.

Wet Alluvial Land

Wet alluvial land (Wa) consists of calcareous, poorly drained soils that have a silt loam or silty clay loam subsoil. This land occurs on nearly level bottom lands near the mouth of Cool Creek and in places surrounding State Lake.

Wet alluvial land is an intricate mixture of soils that have varying texture. The surface layer is dark-gray, granular silt loam to silty clay loam. It is underlain by a subsoil that in some places is silt loam and in other places is silty clay loam. The subsoil is spotted with dark brown. It has weak subangular blocky structure. Below a depth of 36 inches, the soil material is gray silty clay loam to silty clay that is distinctly marked with spots and streaks of dark brown. In most places this land is calcareous throughout, but in some places it is neutral in the upper 6 inches.

Included in areas mapped as Wet alluvial land are small areas of Humbarger loam; Humbarger clay loam; Hobbs silt loam; and Muir silt loam, 0 to 1 percent slopes.

In some depressions there is a puddled silty clay loam or silty clay surface layer that, when it dries, breaks into hard, flat, irregularly shaped pieces. In other depressions are slickspots that, when dry, have a hard, gray crust. A dark-colored, massive silty clay loam layer may occur at any depth.

This land is suitable as rangeland and wildlife areas. Capability unit Vw–1; Subirrigated range site; windbreak suitability group 1.

Use and Management of Soils

The soils of Republic County are used mostly for dryland farming, and to a smaller extent for irrigated farm-

ing. This section explains how the soils may be managed for these main purposes and gives the predicted yields of the principal dryland crops. In addition, it explains how the soils can be managed as rangeland, for windbreaks, and for wildlife habitat, as well as for building highways, dikes or levees, and other engineering structures.

In discussing management of cropland and rangeland, the procedure is to describe groups of soils that have similar uses and that require similar management, and then to suggest management suitable for the group. The soils in each group are listed in the "Guide to Mapping Units" at the back of this survey.

Farming in the county has been and continues to be mainly dryland farming, though a few farmers occasionally apply irrigation water to some fields during droughts. The importance of irrigated farming has increased with the development of the Bostwick Irrigation District in the western part of the county.

Nearly all of the dryland and irrigated farms are of the cash-grain or the cash-grain and beef-cattle type. The crops commonly grown in the county are corn, grain sorghum, forage sorghum, wheat, and alfalfa. Other silage crops, small grain, green-manure crops, and sudangrass and other emergency crops can also be used. The number of cattle on a farm ranges from a few cross breeds for fattening to large herds of pure breed. Instead of beef cattle, a few farms have sheep, swine, or dairy herds.

Capability Groups of Soils

Capability classification is the grouping of soils to show, in a general way, their suitability for most kinds of farming. It is a practical classification based on limitations of the soils, the risk of damage when they are used, and the way they respond to treatment. The soils are classified according to degree and kind of permanent limitation, but without consideration of major and generally expensive landforming that would change the slope, depth, or other characteristics of the soils; and without consideration of possible but unlikely major reclamation projects.

In the capability system, all kinds of soils are grouped at three levels, the capability class, subclass, and unit. These are discussed in the following paragraphs.

Capability Classes, the broadest grouping, are designated by Roman numerals I through VIII. The numerals indicate progressively greater limitations and narrower choices for practical use. Classes are defined as follows:

Class I. Soils have few limitations that restrict their use.

Class II. Soils have some limitations that reduce the choice of plants or require moderate conservation practices.

Class III. Soils have severe limitations that reduce the choice of plants, require special conservation practices, or both.

Class IV. Soils have very severe limitations that restrict the choice of plants, require very careful management, or both.

Class V. Soils subject to little or no erosion but have other limitations, impractical to remove, that limit their use largely to pasture, range, woodland, or wildlife food and cover.

Class VI. Soils have severe limitations that make them generally unsuited to cultivation and limit their use largely to pasture or range, woodland, or wildlife food and cover.

Class VII. Soils have very severe limitations that make them unsuited to cultivation and that restrict their use largely to grazing, woodland, or wildlife.

Class VIII. Soils and landforms have limitations that preclude their use for commercial plant production and restrict their use to recreation, wildlife, or water supply, or to esthetic purposes.

Capability Subclasses are soil groups within one class; they are designated by adding a small letter, *e*, *w*, *s*, or *c*, to the class numeral, for example, IIe. The letter *e* shows that the main limitation is risk of erosion unless close-growing plant cover is maintained; *w* shows that water in or on the soil interferes with plant growth or cultivation (in some soils the wetness can be partly corrected by artificial drainage); *s* shows that the soil is limited mainly because it is shallow, droughty, or stony; and *c*, used in some parts of the United States but not in Republic County, shows that the chief limitation is climate that is too cold or too dry.

In class I there are no subclasses, because the soils of this class have few limitations. Class V can contain, at the most, only subclasses indicated by *w*, *s*, and *c*, because the soils in it are subject to little or no erosion, though they have other limitations that restrict their use largely to pasture, range, woodland, wildlife, or recreation.

Capability Units are soil groups within the subclasses. The soils in one capability unit are enough alike to be suited to the same crops and pasture plants, to require similar management, and to have similar productivity and other responses to management. Thus, the capability unit is a convenient grouping for making many statements about management of soils. Capability units are generally designated by adding an Arabic numeral to the subclass symbol, for example, IIe–2 or IIIe–1. Thus, in one symbol, the Roman numeral designates the capability class, or degree of limitation, and the small letter indicates the subclass, or kind of limitation, as defined in the foregoing paragraph. The Arabic numeral specifically identifies the capability unit within each subclass. In the following pages the capability units in Republic County are described and suggestions for the use and management of the soils are given. All the soils in the county have been placed in capability units according to their suitability for dryland use, and those soils suitable for irrigation have been placed in capability units according to their suitability for irrigated use.

Management of dryland capability units

The dryland capability units described in this subsection account for all the mapping units in the county, though the soils in each capability unit are not listed in the description of the unit. To find the capability unit

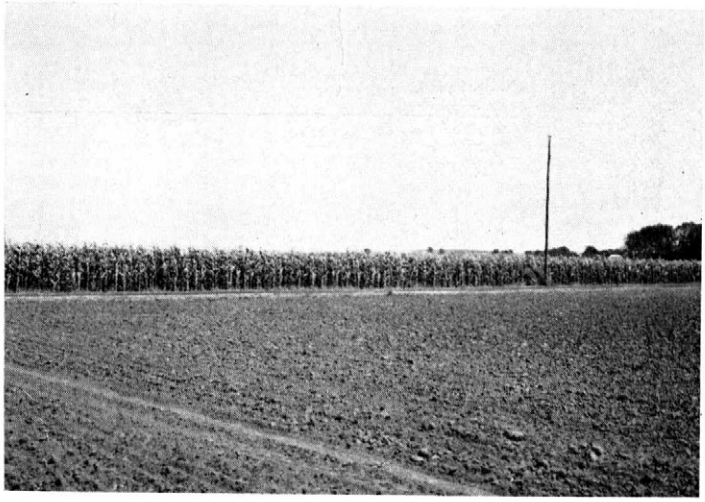


Figure 11.—**Cropland on Muir silt loam, 0 to 1 percent slopes in capability unit I–1.**

to which any soil in the county is assigned, refer to that soil in the section "Descriptions of the Soils," or refer to the "Guide to Mapping Units" at the back of this survey.

CAPABILITY UNIT I–1 (DRYLAND)

This unit consists of deep, nearly level, well-drained soils on the terraces and in the uplands. These soils have a dark-colored loam or silt loam surface layer and a friable loam to silty clay loam subsoil. They absorb moisture readily, have a large capacity for storing it, are easily worked, and are highly productive.

All of the crops commonly grown in the area are suitable for the soils in this unit (fig. 11). Melons and other special crops are suitable for the Eudora soil, and vegetable and root crops are suitable for the Muir and Hastings soils. The cropping system can consist mainly of row crops, or it can be adjusted to meet farm needs.

To help reduce loss of water and soil, contour stripcropping is needed on long slopes and contour cultivation on short slopes. In large areas, the use of stubble mulching, crop residue, or winter cover crops suitable for grazing helps to reduce soil blowing. Alternating short-growing crops with tall-growing crops or strips of tall stubble helps to reduce soil blowing and snow drifting. Special tillage to reduce soil blowing may be needed in the larger areas during dry periods. Crop residue, manure, and green-manure crops are beneficial for maintaining fertility and soil tilth.

CAPABILITY UNIT IIe–1 (DRYLAND)

Only Crete silt loam, 1 to 3 percent slopes, is in this unit. This deep, well-drained, gently sloping soil occurs in the uplands. It has a dark-colored surface layer. The upper part of the subsoil is friable, and the lower part is silty clay.

This soil is slowly permeable and has a high capacity for holding available moisture. It is easily worked when slightly moist and is moderately to highly productive.

All of the crops commonly grown in the area are suitable for this soil. Unless the distribution of rainfall is particularly favorable, grain sorghum is better suited than corn. Cropping can be moderately intensive, but row crops should not be grown for more than 3 to 5 successive years. Soil moisture is used effectively if wheat follows alfalfa or sweetclover that has been plowed under early in summer. To help maintain fertility and tilth where legumes are not grown regularly, manure can be added or green-manure crops suitable for grazing can be grown. Crop residue protects the soil from erosion if it is left on the surface until it is time to plow it under in preparation for the next crop.

Contour cultivation, terraces, and grassed waterways are needed for reducing loss of water and soil from areas in which row crops are regularly grown (fig. 12). Only contour cultivation and grassed waterways are needed in some areas that have slopes of less than 2 percent, and in some areas in continuous wheat. Farming on the contour helps reduce loss of water and soil on the short slopes.

CAPABILITY UNIT IIe–2 (DRYLAND)

The only soil in this unit is Hastings silt loam, 1 to 3 percent slopes. This deep, well-drained soil occurs in the nearly level uplands. It has a dark-colored surface layer and a friable silty clay loam subsoil.

This soil has moderately slow permeability and high capacity for storing available moisture. It is easily worked when slightly moist and is highly productive.

All of the crops commonly grown in the area are suitable for this soil. Cropping can be moderately intensive; row crops can be grown for as many as 4 to 6 successive years. Corn or wheat can follow alfalfa or sweetclover that has been plowed under in spring or early in summer. To help maintain fertility and tilth, sweetclover or other green-manure crops suitable for grazing can be grown, or manure can be added. Crop residue protects the soil from erosion if it is left on the surface until time to plow it under in preparation for the next crop.

Contour cultivation, terraces, and grassed waterways are needed for reducing loss of water and soil from areas in which row crops are regularly grown. Only contour cultivation and grassed waterways are needed in isolated

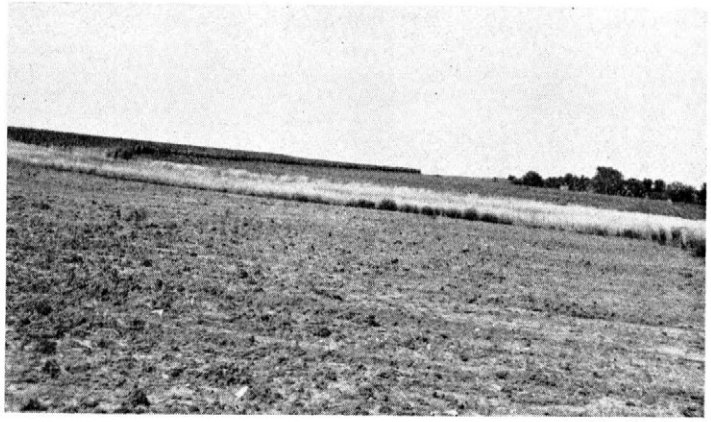


Figure 12.—**Contour cultivation, terraces, and grassed waterway on soils in capability units IIe–1 and IIIe–1. In the background, grain sorghum is planted on Crete silt loam, 1 to 3 percent slopes, and plowed wheat stubble is on the soils in capability unit IIIe–1. Terraces that empty into the grassed waterway separate the grain sorghum from the stubble.**

areas, and in some areas in continuous wheat. Farming on the contour is beneficial in reducing loss of water and soil on the short slopes.

CAPABILITY UNIT IIw-1 (DRYLAND)

This unit consists of deep, well-drained, nearly level to gently undulating, loamy soils on bottom lands that may be flooded during any season of the year. The floods only slightly damage these soils in some years, but in other years they cause serious damage and deposit sediments.

The loamy surface layer of these soils is dark or light colored, and the subsoil is fine sandy loam or silt loam to silty clay loam. Permeability is moderate to moderately slow, and available moisture capacity is moderate to high. These soils are highly productive.

All of the crops commonly grown in the area are suitable for the soils in this unit, but the main crops are corn, grain sorghum, and other row crops and special, or truck, crops. Small grain and hay crops occupy a small acreage. Row crops can be grown on the Humbarger and Hobbs soils for more than 5 successive years, but the Carr soils should not be planted to row crops for more than 5 years. Crop residue protects the soil from erosion and helps to maintain fertility and tilth if it is left on the surface until it is time to plow it under. In addition to crop residue, cover crops or manure are needed on the Carr soils.

Some spots need additions of minor elements. On these soils practices are needed to reduce runoff and to prevent ponding in the slight depressions. Stubble mulch or alternating strips of short-growing crops and tall-growing crops can be used to reduce soil blowing or snow drifting. In places dikes are needed to reduce damage by flooding. Gray spots that are moderately high in sodium require additions of gypsum or heavy applications of manure, and in spots, additions of minor elements.

CAPABILITY UNIT IIs-1 (DRYLAND)

This unit consists of nearly level, deep, moderately well drained and well drained soils. These soils have a dark-colored, loamy surface layer, an upper subsoil of friable silty clay loam, and a lower subsoil of heavy silty clay loam or silty clay.

These soils are easily worked only when slightly moist, and they are slow both to dry out or to become wet. They are slowly permeable, have a high available moisture capacity, and are moderately to highly productive.

All of the crops commonly grown in the county are suitable for these soils. Unless the distribution of rainfall is particularly favorable, grain sorghum is better suited than corn. During wet seasons fields in row crops may become weedy unless practices for weed control are applied. Cropping can be intensive, but row crops should not be grown for more than 5 to 8 successive years. Soil moisture is effectively used if wheat follows alfalfa. Crop residue protects the soil from erosion if it is left on the surface until time to plow it under. To maintain fertility and tilth, winter cover crops suitable for grazing can be grown.

The soils in this unit may need drainage ditches where ponding in shallow depressions is a problem. On the Detroit soil, diversion terraces or drainage ditches may be needed to help prevent ponding. In some areas level terraces can be used on higher adjacent soils to keep runoff from accumulating on the Detroit soil. Stubble mulch or alternate strips of short-growing crops and tall-growing crops can be used to reduce soil blowing or snow drifting.

CAPABILITY UNIT IIs-2 (DRYLAND)

The only soil in this unit is Butler silt loam, thin surface variant. This moderately well drained, deep soil occurs in broad, shallow depressions. Its surface layer is thin, and the upper part of the subsoil is plastic silty clay.

This soil is easily worked only when it is slightly moist, and it is slow both to dry out or become wet. It is very slowly permeable, has moderate capacity for storing available moisture, and is moderately productive.

All of the crops commonly grown in the county are suitable for this soil. Unless the distribution of rainfall is particularly favorable, grain sorghum is better suited than corn. During rainy periods fields in row crops often become weedy unless practices are used for weed control. The cropping sequence should include row crops for not more than 3 or 4 successive years. Soil moisture is used effectively if wheat follows a hay crop. Ponded spots often occur in alfalfa fields. To help maintain or improve granulation in the plow layer, wheat or other fibrous root crops can be used. Crop residue left on the surface reduces soil blowing and snow drifting, and it protects the soil and helps to maintain fertility and tilth. Planting and harvesting on this soil are often delayed because surface moisture is excessive.

This soil should be farmed so as to allow slow drainage of excessive surface moisture. Drainage ditches are needed for removing excessive moisture from closed depressions. This soil should not be plowed or worked when it is so wet that it puddles.

CAPABILITY UNIT IIIe-1 (DRYLAND)

This unit consists of deep, well-drained, eroded soils on nearly level to sloping uplands. These soils have a grayish-brown or brown to dark grayish-brown loamy surface layer and a clay loam, silty clay loam, or silty clay subsoil. The substratum is limy.

The soils in this unit are easily worked when they are only slightly moist, but they are sticky when wet. They have moderately slow permeability and moderate to high capacity for storing available moisture. Yields are moderate to high.

All of the crops commonly grown in the county are suitable for the soils in this unit. Unless the distribution of rainfall is particularly favorable, grain sorghum is better suited to the Crete soil than corn. Soil moisture is used effectively if wheat follows alfalfa or green-manure crops. The cropping system should not include row crops for more than 3 consecutive years. Unless droughts prevent new seedings from growing, alfalfa needs to be shifted every 3 or 4 years. Green-manure or cover crops can be used to supplement the cropping system and help maintain yields and tilth. Crop residue or stubble mulch protects these soils when they are not in growing plants.

Contour cultivation, terraces, and grassed waterways are needed to help reduce loss of soil and water from fields used regularly for row crops. Contour stripcropping may be needed to supplement the terraces. Only terraces or contour cultivation, with or without the

grassed waterways, is needed in some areas in continuous wheat. Farming on the contour helps to reduce loss of water and soil on short slopes.

CAPABILITY UNIT IIIe-2 (DRYLAND)

This unit consists of well-drained, deep to moderately deep loams on sloping uplands. The surface layer of these soils is dark grayish brown or brownish, the subsoil is brown or reddish-brown clay loam, and the substratum is reddish brown and nonlimy. The soils in this unit are easily worked when slightly moist, but they are sticky when wet. They have moderately slow permeability and a large capacity for storing available moisture, and they are moderately productive.

All of the crops commonly grown in the area are suitable for the soils in this unit. The cropping system should include row crops for not more than 3 successive years. Small grain or row crops can be used to follow alfalfa or green-manure crops that are plowed under in spring or early in summer. Alfalfa needs to be shifted from one field to another every 3 or 4 years unless droughts prevent the growth of new seedings. Green-manure or cover crops can be grown, or manure can be added to help maintain fertility and improve soil tilth. Crop residue or stubble mulch protects these soils from erosion if it is left on the surface until time to plow it under.

Contour cultivation, terraces, and grassed waterways are needed for reducing loss of water and soil from fields regularly used for row crops. Contour stripcropping may be needed to supplement the terraces. Only terraces or contour cultivation, with or without grassed waterways, is needed in some areas in continuous wheat. Farming on the contour helps reduce loss of water and soil on the short slopes.

CAPABILITY UNIT IIIe-3 (DRYLAND)

This unit consists of deep, well-drained loamy soils. These soils are sloping and occur on terraces, on the short slopes or escarpments between the terraces, and on uplands.

These soils have a grayish-brown to dark grayish-brown surface layer and a loamy subsoil. Permeability and capacity for storing available moisture are moderate. These soils are moderately productive, and they are easily worked within a wide range of moisture content.

All of the crops commonly grown in the area are suitable for the soils in this unit. In the cropping system row crops should not be grown for more than 2 or 3 successive years. Small grain or row crops can be used after alfalfa is plowed under in spring or early in summer. After 4 or 5 years, alfalfa needs to be shifted from one field to another. Crop residue, a cover crop, or manure is useful in maintaining fertility and soil tilth and in reducing soil blowing and snow drifting.

For reducing loss of water and soil, contour cultivation or contour stripcropping is needed. In addition, grassed waterways may be required, and terraces are needed on long slopes.

CAPABILITY UNIT IIIe-4 (DRYLAND)

This unit consists of deep or moderately deep, well-drained, sloping soils on uplands. These soils have a dark grayish-brown loamy surface layer, a subsoil of clay loam, silty clay loam, or silty clay, and a limy substratum.

The soils of this unit have moderately slow permeability and a moderate to large capacity for storing available moisture. They are easily worked when slightly moist and are moderately to highly productive.

All of the crops commonly grown in the area are suitable for the soils in this unit. Unless the distribution of rainfall is particularly favorable, grain sorghum is better suited to the Crete and Englund soils than is corn. Soil moisture is used effectively on these soils if wheat follows alfalfa or a green-manure crop. The cropping system should include row crops for not more than 4 or 5 successive years. Unless droughts prevent the growth of new seedings, alfalfa should be shifted from one field to another every 3 or 4 years. Green manure, a cover crop, or barnyard manure helps to maintain fertility and soil tilth. After a crop is harvested, these soils should be protected by crop residue until the next crop is planted.

Contour cultivation, terraces, and grassed waterways are needed to help reduce loss of water and soil from fields regularly planted to row crops. Fields used continuously for wheat may need only terraces or contour cultivation, supported in some places by grassed waterways. Farming on the contour helps reduce loss of water and soil on the short slopes.

CAPABILITY UNIT IIIw-1 (DRYLAND)

The only soil in this unit is Humbarger clay loam. This deep, moderately well drained soil is in depressions on the flood plain along the Republican River. It may be flooded at any time of the year. In some years the floods are minor and damage crops only slightly, but in other years crops are seriously damaged and sediments are deposited.

The surface layer of this soil is dark colored, the subsoil is silty clay loam or clay loam, and the substratum is sandy. In some places gray spots occur that are moderately high in sodium.

This soil is easily worked only when slightly moist, and it is sticky when wet. It has moderately slow permeability and a high capacity for storing available moisture. Yields are moderate to high.

This soil is used mainly for corn, grain sorghum, and forage sorghum, but it is suitable for all crops commonly grown in the area. In some fields row crops can be grown for 5 to 8 successive years. Small grain and legumes are also suitable.

Drainage is the main problem in management of this soil. Field operations are delayed and crop yields are reduced by excessive moisture during wet years and by runoff from adjoining slopes at other times. Drainage ditches are needed in places. In broad areas drainage and moisture distribution can be improved by land leveling or by border ditches. In places dikes are needed to control flooding. Stubble mulching or alternating tall-growing crops with short-growing crops reduces soil blowing or snow drifting. The use of crop residue helps to control erosion and to maintain fertility and tilth. The gray spots that are moderately high in sodium require additions of gypsum or heavy applications of manure.

CAPABILITY UNIT IIIw-2 (DRYLAND)

Only Sarpy loamy fine sand is in this unit. This deep, excessively drained soil occurs on the flood plain along the Republican River. It may be flooded at any time of the year. In some years the floods are minor and damage crops only slightly, but in other years crops are seriously damaged and sediments are deposited.

The surface layer of this soil is grayish brown to dark grayish brown, and the subsoil is loose loamy sand. Loose sand makes up the substratum.

This soil has moderately rapid permeability and low capacity for storing moisture. It is easily worked and has moderately low productivity.

All of the crops commonly grown in the area, and some special crops, are suitable for this soil. During years when rainfall is below normal, crops seeded in fall are better suited than crops seeded in spring. The cropping system should include row crops for not more than 3 or 4 successive years. Special crops that produce little residue should be limited to not more than 2 successive years. Soil moisture is used effectively if wheat follows alfalfa. To help maintain fertility and tilth, cover crops can be grown, or manure can be added. Crop residue and mulches protect the soil from erosion until it is time to plow them under.

Stubble mulching or alternating tall-growing crops with short-growing crops helps to reduce soil blowing and snow drifting. If wheat and hay crops are seeded in stubble, soil blowing and damage to seedlings are reduced. In places dikes are needed to reduce flooding.

CAPABILITY UNIT IVe—1 (DRYLAND)

This unit consists of deep, well-drained, eroded or severely eroded soils in the nearly level to sloping uplands. The surface layer and subsoil are silty clay loam to clay loam or silty clay that is underlain by limy silty clay loam.

The soils in this unit are easily worked only when slightly moist, and they are sticky when wet. They have moderately slow permeability and moderate capacity for storing available moisture. Crop yields are moderate.

All of the crops commonly grown in the area are suitable for the soils in this unit, but small grain and hay are more suitable than row crops. Except when the distribution of rainfall is especially good, grain sorghum is better suited than corn. Among the suitable crops are long-term grain grown with hay or wheat grown continuously. Row crops should not be grown for more than 2 successive years. They should be followed by 4 to 6 years of small grain or hay before another row crop is planted. Stubble mulching should be used on fields in continuous wheat to reduce the loss of water and soil. To help maintain yields and tilth, sweetclover or manure can be used to supplement the stubble or hay. By using the residue from each crop, the soil is protected until it is time to work the residue into the soil and plant the next crop.

The practices needed on fields that are regularly cropped depend on the crop used. Where these soils are used only for small grain and hay, contour cultivation or contour stripcropping, along with grassed waterways, is generally sufficient. On long slopes, terraces also may be needed. On short slopes in continuous wheat, only contour cultivation and grassed waterways are needed if crop residue is used for additional protection. Areas not suitable for these practices should be seeded to hay or pasture.

CAPABILITY UNIT IVe-2 (DRYLAND)

This unit consists of deep, well-drained silt loams that occur on sloping uplands. These soils have a grayish-brown to dark grayish-brown silt loam surface layer, a friable silt loam subsoil, and a silt loam substratum.

The soils of this unit have moderate permeability and moderate capacity for storing available moisture. They are easily worked and are moderately productive.

All of the crops commonly grown in the area are suited to the soils in this unit, but small grain and hay or pasture are more suitable than row crops. Row crops should not be grown for more than 1 or 2 successive years. Where slopes are more than 8 percent, a row crop should be grown only once every 6 to 7 years, and it should be followed by at least 5 years of small grain or hay. Among the suitable crops are long-term grain and hay or continuous wheat. For maintaining fertility and soil tilth, manure or sweetclover can be used to supplement the cropping system. By using the residue from each crop, the soil is protected until it is time to work the residue into the soil and plant the next crop.

The practices needed on fields that are regularly cropped depend on the crops used. In areas used only for small grain and hay, contour cultivation or contour stripcropping, along with grassed waterways, is generally sufficient. On long slopes, terraces are needed for additional protection. Stubble mulching protects the soil from loss of soil and water.

CAPABILITY UNIT Vw-1 (DRYLAND)

Only Wet alluvial land is in this unit. It occurs on low bottom lands and is deep, poorly drained, and frequently flooded.

The surface layer of this land is dark-colored silt loam or silty clay loam, and the subsoil is dark grayish-brown silty clay loam or silty clay. In a few small spots, the surface layer is gray silty clay that is moderately high in sodium. The water table fluctuates and is generally within a depth of 5 feet.

Wet alluvial land is usually so wet that it is not suitable for cultivation, but it can be used as range, for windbreaks, and for wildlife food and cover. A large amount of good forage is produced because the plant mixture is subirrigated by water from the high water table.

CAPABILITY UNIT VIe-1 (DRYLAND)

This unit consists of excessively drained to well-drained, sloping to steep, very shallow to moderately deep soils on uplands. These soils have a dark-colored surface layer that, in most places, is underlain by weathered limestone and shale or sandstone and shale. In some places the surface layer is underlain by a thin, clayey subsoil that, in turn, is underlain by weathered sandstone and shale or only shale.

The soils in this unit are so steep and so stony and shallow that they are not suitable for cultivation. Small areas of moderately deep soil occur in some places, but it

is not practical to cultivate these areas. The soils in this unit can be used as rangeland, windbreaks, or wildlife food and cover.

The original native vegetation consisted of desirable range plants, but these have been removed by overgrazing, and many annuals, weeds, and brushy plants have invaded.

CAPABILITY UNIT VIe-2 (DRYLAND)

Only Breaks-Alluvial land complex is in this unit. It consists of moderately well drained soils on bottom lands and deep, well drained soils on the adjoining steep, broken, side slopes. The soils on bottom lands have a dark-colored silty surface layer and a dark-colored clayey subsoil. The soils on the side slopes have a dark-colored loamy surface layer and a grayish-brown, brown, or reddish-brown silty clay loam subsoil. Narrow strips of very shallow soil occur, and rock crops out in some places.

The soils in this complex are so steep or so frequently flooded and irregular that they are not suitable for cultivation. They can be used as rangeland, trees in windbreaks, or wildlife food and cover. The native vegetation consisted of a mixture of tall grasses and, along the larger streams, somewhat open stands of hardwood trees. The larger trees, except cottonwoods, have been removed, and few of the remaining trees are marketable. The percentage of tall grasses in the present vegetation varies a great deal.

CAPABILITY UNIT VIe-3 (DRYLAND)

Only Sarpy soils, duned, are in this capability unit. These deep, droughty soils occur as sand dunes in the valleys of the Republican River and Otter (Sandy) Creek. They have a slightly dark loamy fine sand surface layer that grades to a brownish, loose sand subsoil.

The soils in this unit are so droughty and so rough that they are not suitable for cultivation. At one time these soils were covered with grasses that are more desirable than the sand dropseed, fall witchgrass, and purple lovegrass that are now dominant and the windmillgrass, sandbur, and western ragweed that have invaded.

CAPABILITY UNIT VIIe-1 (DRYLAND)

Only Rough broken land is in this capability unit. This land type occurs on rough, broken slopes of the uplands. It has a dark-colored, loamy surface layer and a brownish silty clay loam subsoil. Except in gravelly or sandy spots, moisture-holding capacity is good.

This land is so steep and so rough that it is not suitable for cultivation. Only a small percentage of the desirable grasses that once covered this land remains, and various annuals, weeds, and some brush have invaded.

Management of irrigated capability units

In this subsection the irrigated capability units in Republic County are described, and suggestions for use and management of the soils are given, though the soils in each capability unit are not listed in the description of the unit. To find the irrigated capability unit to which a soil has been assigned, refer to the "Guide to Mapping Units" at the back of this survey. The soils in the county that are not suitable for irrigation have not been placed in irrigated capability units.

CAPABILITY UNIT I-2 (IRRIGATED)

This unit consists of nearly level, deep, well drained and moderately well drained soils on terraces and uplands. These soils have a loamy surface layer and a friable loam, silt loam, or silty clay loam subsoil.

The soils in this unit are easily worked. They have a water intake rate of 0.4 to 1.0 inch per hour, and to a depth of 4 feet they can hold 7 to 9 inches of available moisture.

These soils are highly productive and are suitable for all the crops commonly grown in the county. They are used mainly for row crops, but small grain, hay, grass, and other crops are also grown. Row crops need adequate additions of fertilizer and crop residue worked into the soil. When the plow layer begins to lose structure, hay or grass can be grown, or manure can be added, so as to help maintain soil tilth. In winter crop residue is needed for protection.

These soils can be irrigated by gravity where they can be leveled and bordered. The leveling should be done to fit the particular field. Row crops can be irrigated by furrows, and small grain can be irrigated by furrows or by flooding. A drainage system made up of grassed waterways or dikes is needed to remove excessive irrigation water or rainfall. Where leveling is not feasible, sprinklers can be used.

Row crops that produce little crop residue should be limited to about 5 successive years. If these soils are not leveled and are irrigated by sprinklers, row crops should be limited to about 4 or 5 successive years. About 2 or 3 years of small grain or hay is needed between the periods when row crops are grown.

CAPABILITY UNIT IIe-3 (IRRIGATED)

This unit consists of deep, gently sloping, well-drained soils on uplands. These soils have a silt loam surface layer and a silty clay loam or silty clay subsoil.

The soils in this unit are easily worked when slightly moist. They have a water intake rate of 0.2 to 0.5 inch per hour, and to a depth of 4 feet they can hold 8 to 9 inches of available moisture.

These soils are highly productive and are suitable for all the crops commonly grown in the county. When the plow layer begins to lose structure, small grain, hay, or grass can be grown, or manure can be added so as to help maintain soil tilth. Crop residue is needed to protect the soil in winter.

If these soils are irrigated by gravity, they may need parallel or contour benches that are constructed to fit the particular field. Row crops can be irrigated by furrows, and other crops can be irrigated by shallow furrows or by flooding. If benches are not feasible, these soils can be irrigated on contours, and terraces can be used to control runoff. In these areas crops are irrigated by contour furrows. These soils can be irrigated by sprinklers if contour cultivation and terraces are used to help control runoff. Grassed waterways or ditches can be used for removing runoff.

On the benches these soils can be used mainly for row crops if adequate amounts of fertilizer are added and crop residue is worked into the soil. If contour irrigation or sprinklers are used, row crops should be limited to 5 or 6 consecutive years. About 2 or 3 years of small

grain or hay is used between the periods when row crops are grown. Row crops that produce little residue should be limited to about 3 consecutive years.

CAPABILITY UNIT IIw–2 (IRRIGATED)

This unit consists of nearly level to gently undulating, deep, well drained and moderately well drained, loamy soils on the flood plains. These soils have a loamy surface layer and a sandy loam, loam, silt loam, or silty clay loam subsoil. They may be flooded during any season of the year. Some floods are minor and only slightly damage crops; others severely damage crops and deposit sediments.

These soils are easily worked. They have a water intake rate of 0.5 to 1.0 inch per hour and, to a depth of 4 feet, an available moisture capacity of 6 to 8 inches.

The soils in this unit are highly productive and are suitable for all the crops commonly grown in the county. They are used for row crops, small grain, hay, and other close-growing crops. Row crops require adequate additions of fertilizer and crop residue worked into the soil. Crop residue is needed on the surface to protect these soils in winter.

If these soils are irrigated by gravity, they may need to be leveled and bordered. This should be done to fit the separate soil areas, and the areas should not include soils having varying water intake rates. In some places, only slight leveling is needed. Sprinkler irrigation is suitable where leveling is not feasible. Row crops can be irrigated by furrows, and close-growing crops can be irrigated by furrows or by flooding. Where these soils are leveled, they should be protected by levees if it is practical to do so. In some areas, depth to underlying loose sand should be checked before the leveling is planned.

On Carr fine sandy loam, 2 or 3 years of small grain, hay, or grass should follow 6 to 8 years of row crops. This soil also needs applications of manure. All the soils in this unit need crop residue on the surface for protection during winter. These soils are cropped in about the same way, regardless of the kind of irrigation used. A drainage system is needed so as to remove runoff and prevent ponding.

CAPABILITY UNIT IIs–3 (IRRIGATED)

This unit consists of nearly level, deep, well drained and moderately well drained silt loams on uplands. The subsoil of these soils is silty clay.

These soils are easily worked when they are only slightly moist. They have a water intake rate of 0.1 to 0.3 inch per hour, and they can hold 7 to 9 inches of available moisture within a depth of 4 feet.

The soils in this unit are moderately productive and are suitable for all the crops commonly grown in the county. They are used mainly for row crops. If row crops are grown, adequate additions of fertilizer are needed, as well as crop residue worked into the soil. Crop residue is needed on the surface for protection in winter. Manure is added when it is available.

Land leveling and bordering or benching are needed if these soils are to be irrigated by gravity. Small fields require only slight leveling. Generally, sprinkler irrigation is not suitable on these soils. Row crops can be irrigated by furrows, and other crops can be irrigated by shallow furrows or by flooding. A row crop that produces little residue should be limited to 4 or 5 consecutive years. Grassed waterways or ditches help to remove runoff.

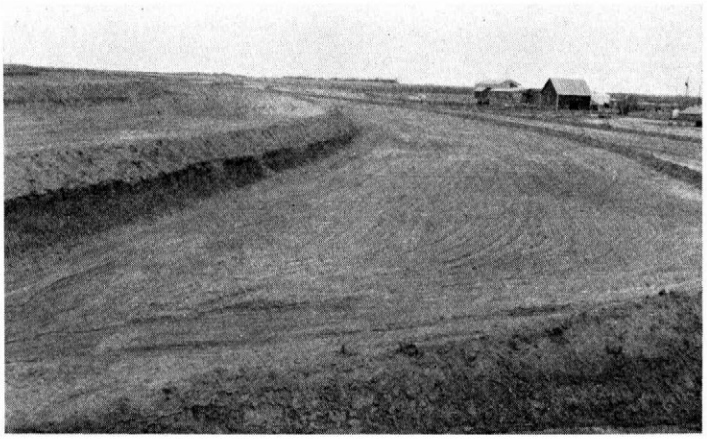


Figure 13.—**Contour benches on soils in capability unit IIIe–5 that are ready to be planted.**

CAPABILITY UNIT IIIe–5 (IRRIGATED)

This unit consists of deep, well-drained soils on gently sloping uplands. These soils have a loamy surface layer and a subsoil of clay loam, silty clay loam, or silty clay.

The soils in this unit are easily worked when slightly moist. The water intake rate is 0.3 to 0.8 inch per hour, and to a depth of 4 feet, 7 to 9 inches of available moisture can be held in these soils.

These soils are suitable for close-growing crops and, in some areas, for row crops. Production is moderate to high. Row crops require adequate additions of fertilizer, as well as crop residue worked into the soil. Crop residue is needed on the surface to protect these soils in winter.

These soils can be irrigated by gravity on parallel or contour benches (fig. 13) or by the contour method. Contour cultivation, terracing, and grassed waterways are needed in areas irrigated on contours. Contour stripcropping may also be used for reducing loss of water and soil. Regardless of the type of irrigation used, row crops are irrigated by furrows. Close-growing crops are irrigated by furrows or by flooding on benches, and by furrows in areas that are irrigated on the contours. If these soils are irrigated by sprinklers, contour cultivation, stripcropping, terracing, and grassed waterways are needed. Drainage systems are needed to remove runoff and prevent gullying or ponding.

Row crops that produce little residue should be limited to 4 successive years, but close-growing crops can be grown continuously if desired. In areas that are irrigated on the contour or by sprinklers, row crops should be limited to 4 consecutive years. After row crops are grown for 2 or 3 years, additions of available manure are needed. Two or four years of small grain, hay, or pasture can be used between the periods when row crops are grown.

CAPABILITY UNIT IIIe–6 (IRRIGATED)

This unit consists of deep, well-drained soils that are on nearly level to sloping terraces and uplands. The

surface layer is loamy, and the subsoil is loam, silt loam, or clay loam.

The soils in this unit are easily worked. They have a water intake rate of 0.7 to 1.25 inches per hour, and they can hold 6 to 8 inches of available moisture to a depth of 4 feet.

These soils are moderately productive and are suitable for all the crops commonly grown in the county. Crop residue on the surface helps to protect the soil in winter and to maintain fertility and tilth. Available manure also needs to be applied if row crops are grown.

The soils in this unit can be irrigated by using parallel or contour benches, by the contour method, or by sprinklers. Row crops can be irrigated by furrows, and other crops can be irrigated by furrows or by flooding. Areas irrigated on contours or by sprinklers need contour cultivation or stripcropping, terracing, and grassed waterways.

On the benches these soils can be used mainly for row crops if adequate amounts of fertilizer are added and crop residue is worked into the soil. Row crops that produce little residue should be limited to 3 successive years. Small grain, hay, or pasture can be grown continuously if desired. In areas irrigated on the contour or by sprinklers, row crops should be limited to 3 or 4 years. Between the periods when row crops are grown, small grain, hay, or pasture is needed for 2 to 4 years. On short slopes, these soils can be seeded to small grain or to hay or pasture plants if corrugation irrigation is used. A drainage system is needed so as to remove runoff and prevent gullying or ponding.

CAPABILITY UNIT IIIw–4 (IRRIGATED)

The only soil in this unit is Sarpy loamy fine sand. This gently sloping, loose sandy soil occurs on the flood plains. It has a surface layer darkened by organic matter and a loose loamy sand subsoil. This soil may be flooded at any time of the year. Some floods are minor and only slightly damage crops; others severely damage crops and deposit sediments.

This soil is easily worked. It has a water intake rate of about 2 inches per hour, and it can hold 3 to 4 inches of available moisture within a depth of 4 feet.

The soil in this unit is moderately productive. Small grain, hay, or pasture is more suited to this soil than row crops. Melons grow well. If row crops are grown, fertilizer should be added in adequate amounts and all residue should be worked into the soil. Also, available manure is needed on fields in row crops so as to help maintain organic matter and to improve the moisture-holding capacity.

Where this soil is leveled, the cuts should not be so deep that they expose the loamy sand subsoil. Sprinkler irrigation is more suitable than gravity irrigation. Under any irrigation system, however, row crops should not be grown for more than 3 successive years. About 3 to 4 years of small grain, hay, or pasture can be used between the periods when row crops are grown. Melons should be limited to 2 successive years. Because the water intake rate is rapid, this soil should be irrigated independently of the other soils on the flood plains.

CAPABILITY UNIT IVe–4 (IRRIGATED)

This unit consists of deep, well-drained, eroded or severely eroded soils that have a silt loam or silty clay loam subsoil. These nearly level to sloping soils are in the uplands.

The soils in this unit are easily worked only when slightly moist. They have a water intake rate of 0.4 to 0.6 inch per hour, and they can hold 6 to 8 inches of available moisture in the upper 4 feet of soil.

These soils are moderately productive. They are suited to row crops and to small grain, hay, and other close-growing crops. The row crops require adequate additions of fertilizer, crop residue worked into the soil, and additions of available manure. Also, crop residue is needed on the surface for protection during winter.

The soils in this unit can be irrigated by using parallel or contour benches, by the contour method, or by sprinklers. On the benches, row crops can be irrigated by furrows and other crops can be irrigated by furrows or by flooding. Areas irrigated on contours or by sprinklers need contour cultivation or stripcropping, terracing, and grassed waterways.

In the bench-irrigated areas, row crops can be grown for 5 to 10 successive years. About 2 to 4 years of small grain, hay, or pasture should be used between the periods when row crops are grown. In areas irrigated by the contour method or by sprinklers, row crops should be limited to 3 or 4 successive years. Between the periods when row crops are grown, 3 to 5 years of small grain, hay, or pasture should be used, but if these crops are grown, terracing and irrigation by corrugations may be needed.

Predicted Yields on Dryland Soils

Table 2 lists predicted average yields of the principal dryland crops for the soils in the county suitable for cultivation. The predicted yields of the principal crops indicate the yields per acre that are expected over a period of years. These yields do not apply to any field in any particular year. The estimates in table 2 were made on the basis of the information obtained from farmers, agricultural technicians, demonstration plots, and research data.

Crop yields vary widely and are greatly influenced by management practices, weather, and damage from insects or diseases. In estimating the yields, the effects of all factors except management were minimized. The yields in columns A are to be expected under the ordinary management, which is the management used by most farmers. Yields in columns B are expected under exceptional management, or management used by the farmers when they apply most of the latest proven practices.

In the ordinary management (columns A), the soils are worked, plants are seeded, and crops are harvested when time and weather permit. The crop varieties most commonly used in the county, or those available, are planted at the usual seeding rates. Crops are shifted, or rotated, in an irregular sequence. Sweetclover may be grown on the land used for wheat, and some barnyard manure may be put on fields used for row crops.

TABLE 2.—*Predicted average yields per acre for principal dryland crops grown under two levels of management*

Soil name	Principal crops									
	Corn		Grain sorghum		Wheat		Forage sorghum		Alfalfa	
	A	B	A	B	A	B	A	B	A	B
	Bu.	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Tons*	*Tons*	*Tons*	*Tons*
Butler silt loam, thin surface variant	25	40	40	60	22	28	9	12	1. 5	2. 0
Carr fine sandy loam	37	58	42	63	18	26	10	14	2. 0	3. 0
Crete silt loam, 0 to 1 percent slopes	35	45	45	65	26	32	10	14	2. 0	3. 0
Crete silt loam, 1 to 3 percent slopes	35	45	45	65	26	32	10	14	2. 0	3. 0
Crete silty clay loam, 2 to 5 percent slopes, eroded	25	35	38	60	18	25	6	10	1. 5	2. 5
Crete silty clay loam, 3 to 7 percent slopes	30	40	40	62	20	28	9	12	2. 0	3. 0
Detroit silty clay loam	40	60	45	65	24	34	10	14	2. 0	3. 0
Englund silty clay loam' 3 to 7 percent slopes	25	40	35	55	18	26	6	10	1. 5	2. 0
Eudora loam, 0 to 2 percent slopes	45	62	55	72	22	28	10	15	2. 5	3. 5
Eudora loam, 2 to 8 percent slopes	35	50	40	60	16	24	8	12	2. 0	3. 0
Geary-Crete silt loams, 3 to 7 percent slopes:										
Geary soil	32	52	42	65	20	28	10	12	2. 0	3. 0
Crete soil	30	40	40	62	20	28	9	12	2. 0	3. 0
Geary-Crete silty clay loams, 3 to 7 percent slopes, severely eroded:										
Geary soil	26	40	35	50	16	26	6	11	1. 5	2. 5
Crete soil	20	32	30	45	16	26	5	10	1. 5	2. 5
Hastings silt loam, 0 to 1 percent slopes	40	55	48	70	24	32	11	16	2. 5	3. 5
Hastings silt loam, 1 to 3 percent slopes	40	55	48	70	24	32	11	16	2. 5	3. 5
Hastings silt loam, 3 to 7 percent slopes	35	50	45	65	20	28	10	14	2. 0	3. 0
Hastings silty clay loam, 3 to 7 percent slopes, eroded	30	45	42	62	18	26	8	12	2. 0	3. 0
Hastings and Crete soils, 3 to 7 percent slopes, severely eroded:										
Hastings soil	26	40	35	50	16	26	6	10	2. 0	3. 0
Crete soil	20	32	30	45	16	26	5	10	1. 5	2. 5
Hastings soils, eroded-Hobbs complex:										
Hastings soil	26	40	38	55	18	26	7	11	2. 0	3. 0
Hobbs soil	50	65	55	70	20	34	14	18	2. 5	3. 5
Hastings-Ortello fine sandy loams, 1 to 4 percent slopes, eroded:										
Hastings soil	35	50	42	65	22	30	10	14	1. 5	2. 5
Ortello soil	30	40	38	50	18	26	8	12	1. 5	2. 0
Hastings-Ortello fine sandy loams, 4 to 8 percent slopes, eroded:										
Hastings soil	30	42	40	60	18	26	8	12	1. 5	2. 0
Ortello soil	25	35	35	50	16	24	7	11	1. 5	2. 0
Hobbs silt loam	50	65	55	70	20	34	14	18	2. 5	3. 5
Humbarger clay loam	47	63	52	68	26	38	12	16	2. 0	3. 0
Humbarger loam	45	68	52	72	26	40	12	18	3. 0	4. 0
Kenesaw silt loam, 5 to 12 percent slopes	30	45	40	55	20	28	8	12	2. 0	3. 0
Kenesaw silt loam, 5 to 12 percent slopes, eroded	26	42	35	50	16	24	7	10	1. 5	2. 5
Lancaster loam, 4 to 8 percent slopes	30	45	40	60	22	28	8	12	1. 5	2. 5
Lancaster loam, 4 to 8 percent slopes, eroded	25	42	35	55	18	26	7	12	1. 5	2. 5
Muir silt loam, 0 to 1 percent slopes	55	65	60	78	26	32	12	18	3. 0	4. 0
Muir silt loam, 3 to 7 percent slopes, eroded	40	55	50	65	20	28	10	14	2. 5	3. 5
Sarpy loamy fine sand	30	45	35	50	14	24	6	10	1. 5	2. 0
Tully silty clay loam, 4 to 8 percent slopes	35	50	42	65	20	28	10	14	2. 0	3. 0
Tully silty clay loam, 4 to 8 percent slopes, eroded	30	45	40	62	18	26	9	13	2. 0	3. 0

Generally, wheat is better fertilized than other crops. Crops other than wheat are fertilized only occasionally. On many fields no practices are used to reduce loss of water and soil, and on other fields the practices used are not sufficient.

In the exceptional management (columns B), the soils are worked, plants are seeded, and crops are harvested when the soil or crop is in good condition for those operations. The more productive crop varieties are seeded at rates heavier than those used in ordinary management. Crops are shifted, or rotated, in as regular a sequence as the weather permits. Green-manure crops, barnyard manure, and crop residue are used along with alfalfa to help maintain fertility and soil tilth. Commercial fertilizer is applied regularly to wheat and row crops. On most fields, the practices used are sufficient for protection against loss of water and soil, but on some fields additional practices would be beneficial.

Several mapping units are not listed in table 2, because they are not generally used for the main crops grown in the county. Breaks-Alluvial land is used only for pasture and woods. Used only for pasture are Kipson soils, 11 to 30 percent slopes; Lancaster-Hedville loams, 5 to 25 percent slopes; Rough broken land; Sarpy soils, duned; and Wet Alluvial land.

234-641—67——3

Range Management [1]

Rangeland makes up about 20 percent of the total acreage of Republic County. Large areas of rangeland occur in the south-central and southeastern parts of the county, but small areas are scattered throughout the county. Most of the rangeland is on shallow soils that are not suitable for cultivation.

The raising of livestock, mainly feeder cattle, is the second largest agricultural enterprise in Republic County. The success of this enterprise partly depends on the way ranchers and farmers manage their range and feed reserves. Various crossbreeds and purebred cattle make up the livestock, though a few farms maintain registered, purebred herds. The individual herd is not large. According to the census of agriculture in 1959 the total number of cattle and calves in the county was about 50,000.

Range sites

Different kinds of rangeland produce different kinds and amounts of grass. For proper range management, an operator needs to know the different kinds of land or range sites in his holdings and the plants each site can produce. Management can then be used that favors the growth of the best forage plants on each range site.

Range sites are areas of rangeland that differ from each other in their ability to produce significantly different kinds or amounts of climax, or original, vegetation. A significant difference is one that is great enough to require different grazing practices, or other management that maintains or improves the present vegetation.

Climax vegetation is the combination of plants that originally grew on a given site. The most productive combination of range plants on a range site is generally the climax type of vegetation.

Range condition is classified according to the percentage of vegetation on the site that is original, or climax, vegetation. This classification is used for comparing the kind and amount of present vegetation with that which the site can produce, or the climax vegetation. Changes in range condition mainly result from intense grazing and drought. The range condition is *excellent* if the percentage of the original, or climax, plants is more than 75. It is *good* if this percentage is 50 to 75, *fair* if the percentage is 25 to 50, and *poor* if the percentage is less than 25.

In the descriptions of range sites, native vegetation is referred to in terms of *decreasers*, *increasers*, and *invaders*. Decreasers and increasers are climax plants. Decreasers are the most heavily grazed and, consequently, are the first to be injured by overgrazing. Increasers withstand grazing better or are less palatable to the livestock; they increase under grazing and replace the decreasers. Invaders are plants not native to the site that become established after the climax vegetation has been reduced by grazing.

Each mapping unit in the county has been placed in a range site, though the units in each range site are not listed in the following descriptions of the range sites. To find the range site to which any soil in the county is assigned, refer to that soil in the section "Descriptions of the Soils", or refer to the "Guide to Mapping Units" at the back of this survey.

SUBIRRIGATED RANGE SITE

Wet alluvial land, the only mapping unit in this range site, is made up of nearly level, low-lying soils on bottom lands. The surface layer and subsoil are silt loam and silty clay loam. This land is frequently flooded and has a water table that fluctuates between 3 and 5 feet of the surface.

In the climax plant cover is a mixture of big bluestem, switchgrass, indiangrass, prairie cordgrass, and other decreasers. These grasses make up at least 90 percent of the total cover, and perennial grasses and forbs make up the rest. Among the increasers are sedges and rushes. Foxtail barley, buffalograss, tumblegrass, and western wheatgrass are the principal invaders.

The range should be grazed so that not more than one-half of the volume of grass produced each year is removed. If grass production is below normal, the number of grazing animals should be reduced to fit the rate the grasses grow. More uniform grazing can be obtained by dividing large areas with fences, and moving the animals from place to place. Ponds can be dug at different places so that animals do not have to go far to drink and the range is grazed more uniformly. Salt should be placed away from the water supply. It should be put in containers to prevent killing of the vegetation and development of barren spots.

When the seed stalks begin developing, all or part of the range should be rested so that the root systems and vigor of the more desirable plants are increased. Then the range is improved because there is an increase in the top growth and, by seed production, in plant population. Weeds and brush should be controlled by applying chemicals or by mechanical methods. In the low, occasionally ponded areas, drainage is needed so that the more desirable grasses can grow.

LOAMY LOWLAND RANGE SITE

This site is made up of deep, well-drained alluvial soils in the valleys. These soils have a loamy surface layer and a friable loam, silt loam, or silty clay loam subsoil. Water-holding capacity is high, and extra moisture is received in the occasional floods of streams or as runoff from higher lying areas.

In the climax plant cover is a mixture of big bluestem, switchgrass, indiangrass, Canada wildrye, and other decreasers. These grasses make up at least 80 percent of the total cover, and other perennial grasses and forbs make up the rest. The main increasers are western wheatgrass, tall dropseed, and sideoats grama. Ironweed and verbena are common invaders.

If the range is rested during part or all of the growing season, the root systems and vigor of the more desirable plants are increased. Then the range is improved because there is an increase in top growth, and, by seed production, of plant population. On the steep, broken side slopes, this natural revegetation is the only way to improve the range. Weeds and brush can be

[1] PETER N. JENSEN, range conservationist, and F. DEWITT ABBOTT, State soil conservationist, Soil Conservation Service, prepared this subsection.

controlled by applying chemicals or by mechanical methods.

To maintain or improve the range, no more than one-half of the volume of grass produced each year should be removed. The yearly growth rate of the grasses should control the number of grazing animals. During periods of droughts, little or no grazing can be allowed in the sloping areas. Uniform grazing can be obtained if the range is divided by fences, and the animals moved from one enclosure to another. The water supply needs to be developed so that grazing is distributed over the entire range. Salt can also be placed in locations that encourage uniform grazing. The salt should be put in containers to prevent it from entering the soil and developing barren spots.

SANDY LOWLAND RANGE SITE

This site is made up of sandy soils on flood plains along the Republican River. These gently undulating soils have a fine sandy loam or loamy fine sand surface layer and subsoil. They have moderate or moderately rapid permeability. Their water table fluctuates between 5 to 10 feet of the surface.

In the climax plant cover is a mixture of big bluestem, little bluestem, switchgrass, Canada wildrye, and other decreasers. These grasses make up at least 75 percent of the total cover, and other perennial grasses and forbs make up the rest. The main increasers are sideoats grama, sand dropseed, and purpletop. Annuals, willows, and cottonwood trees are the principal invaders.

If the range is rested part or all of the growing season, the range is improved because there is an increase in top growth, roots, and plant vigor of the more desirable plants. These plants can be increased in amount by allowing the plants to produce seed. If remnants of the good range plants are not present, these plants can be seeded.

To maintain or improve the range, no more than one-half of the volume of grass produced each year should be removed. The number of grazing animals is limited to fit the rate the range plants grow. Watering places and salt are distributed to encourage grazing of the entire range. The salt should be placed in containers to prevent the killing of vegetation and development of barren spots.

LOAMY UPLAND RANGE SITE

This site is made up of deep, well-drained soils on nearly level to steep uplands (fig. 14). The surface layer is loam, silt loam, or silty clay loam, and the subsoil is friable silt loam, clay loam, or silty clay loam. These soils have moderately slow or moderate permeability and high water-holding capacity.

In the climax vegetation is a mixture of little bluestem, big bluestem, indiangrass, switchgrass, and other decreasers. These grasses make up at least 70 percent of the total cover, and other perennial grasses and forbs account for the rest. The main increasers are sideoats grama, blue grama, buffalograss, and western wheatgrass. Where overgrazing is continuous, blue grama and buffalograss are dominant. The principal invaders are annuals, ironweed, and verbena.

All or part of the range should be rested during some growing seasons so that the more desirable plants can increase their top growth, root systems, and plant vigor. The population of more desirable plants can be increased by allowing the plants to produce seed. On the rough, broken areas, the practical way to improve the range is through natural vegetation. Weeds and brush can be controlled by use of chemicals or hand-operated equipment.

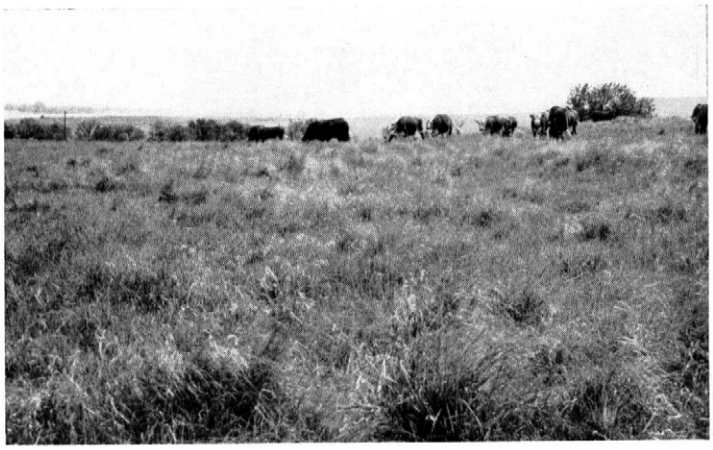


Figure 14.—**Tully silty clay loam in an area of the Loamy Upland range site in excellent condition.**

To maintain or improve the range, no more than one-half of the volume of grass produced each year should be removed. The number of grazing animals can be limited to fit the growth rate of the grasses. If the range is divided by fences, animals can be moved from one enclosure to another so that grazing is more uniform. The water supply and salt should be distributed to encourage grazing of the entire range. The salt should be placed in containers that prevent it from entering the soil and forming barren spots.

CLAY UPLAND RANGE SITE

This site is made up of well-drained soils on nearly level to gently sloping uplands (fig. 15). These soils have a surface layer of silt loam or silty clay loam and a subsoil of silty clay loam or silty clay. They have slow permeability and during summer are droughty because the subsoil is dense and clayey.

In the climax plant cover is a mixture of big bluestem, little bluestem, switchgrass, and other decreasers. These grasses make up at least 40 percent of the total cover, and other perennial grasses and forbs account for the rest. The increasers consist mainly of western wheatgrass, blue grama, sideoats grama, and buffalograss. Where overgrazing is continuous, western wheatgrass or buffalograss may be dominant. Winter annuals and western ragweed are the principal invaders.

All or part of the range should be rested during the growing season so that the more desirable plants increase their top growth, roots, and plant vigor. The more desirable plants can be increased in amount by allowing them to produce seed. Weeds and brush can be controlled by use of chemicals or hand-operated equipment.

To maintain or improve the range, no more than one-half of the volume of grass produced each year should

Figure 15.—**Crete silty clay loam in Clay Upland range site. *Top:* Former cropland that has been seeded to native grass. *Bottom:* Unseeded range site in good condition.**

be removed. The number of grazing animals can be limited to fit the rate that range plants grow. Grazing is uniform if watering places and salt are located properly.

SANDY RANGE SITE

This site is made up of deep, well-drained fine sandy loams that are on gently sloping uplands. The Hastings soils have a fine sandy loam surface layer, a clay loam upper subsoil, and a silty clay loam lower subsoil. The Ortello soils have a fine sandy loam surface layer and a sandy loam to loam subsoil. The soils in this range site have moderate permeability and moderate to high water-holding capacity.

In the climax plant cover is a mixture of big bluestem, little bluestem, switchgrass, sand lovegrass, and other decreasers. These grasses make up at least 60 percent of the total cover, and other perennial grasses and forbs account for the rest. The increasers include sideoats grama, fall witchgrass, and sand dropseed. The principal invaders are windmillgrass, gumweed, and broomweed.

If the range is rested part or all of the growing season, the range is improved because there is an increase in top growth, roots, and plant vigor of the more desirable plants. The more desirable plants can be increased in amount by allowing the plants to produce seed. If remnants of the good range plants are not present, these plants can be seeded.

To maintain or improve the range, no more than one-half of the volume of grass produced each year should be removed. If grass production is below normal, the number of grazing animals is reduced to fit the rate that the grasses grow. This site is highly susceptible to wind erosion if it is not adequately protected by protective cover.

SANDS RANGE SITE

Only Sarpy soils, duned, is in this range site. This site is made up of sand dunes in the valleys of the Republican River and Otter Creek. The surface layer is loamy fine sand that overlies deep, loose loamy sand or sand. Permeability is moderately rapid, and the water-holding capacity is low.

In the climax plant cover is a mixture of big bluestem, little bluestem, indiangrass, switchgrass, sand lovegrass, and other decreasers. These grasses make up at least 75 percent of the total cover, and other perennial grasses and forbs account for the rest. The increasers include sand dropseed, fall witchgrass, and purple lovegrass. The principal invaders are windmillgrass, sandbur, and western ragweed.

To maintain or improve the range, the number of grazing animals should be controlled, and no more than one-half of the volume of grass produced each year should be removed. The larger ranges need to be divided by fences so that animals can be moved from enclosure to enclosure and grazing can be more uniform. Also, the location of watering places and the placement of salt can be used to help distribute grazing throughout the entire range. The salt should be kept in containers that prevent it from reaching the soil and killing the grass.

All or part of the range needs to be rested when the seed stalks begin to develop so that there is an increase of root systems, top growth, and plant vigor in the more desirable plants. The population of the more desirable plants can be increased through seed production. This natural revegetation is the practical way to improve the range. Weeds and brush can be controlled by applying chemicals or by mechanical methods.

BREAKS RANGE SITE

This site is made up mainly of shallow soils on gently sloping to rolling uplands (fig. 16), but there are small areas of moderately deep soils in the sandstone and shale section. The thin loamy surface layer grades into broken bedrock. Rock fragments occur on the surface and throughout the soil, and bedrock crops out in many places. The root zone and moisture-holding capacity vary according to depth to bedrock.

In the climax plant cover is a mixture of little bluestem, big bluestem, switchgrass, indiangrass, and other decreasers. These grasses make up at least 70 percent of the total cover, and other perennial grasses and forbs

Figure 16.—**Breaks range site in good range condition.**

account for the rest. The increasers include sideoats grama and hairy grama, and annuals are the principal invaders.

In order to maintain or improve the range, no more than one-half of the volume of grass produced each year should be removed. The number of grazing animals should be controlled to fit the growth rate of the grasses. If the range is divided by fences, the animals can be moved about so as to obtain uniform grazing. Uniformity in grazing can also be improved by selecting good locations for watering places and for salt. The salt should be placed in containers to prevent killing of the vegetation.

All or part of a range may be rested during some growing seasons so that the more desirable plants can increase their root systems and vigor. Then the range is improved because there is an increase in the top growth and, through seed production, in the plant population. Natural revegetation is the practical way to improve the range on the stony, shallow, or steep soils. Weeds and brush can be controlled by applying chemicals or by mechanical methods.

Estimated yields by range sites

Yields of herbage on a range site vary according to the amount and distribution of rainfall each year. They are also affected by the degree of grazing in past years. In addition, yields are reduced by trampling and by rodents and insects. Following is the estimated total top growth of herbage for each range site, assuming it has received average rainfall throughout the year and is in excellent condition.

Range site:	*Air-dry weight (lb. per acre)*
Subirrigated	6, 000–9, 000
Loamy Lowland	4, 500–7, 000
Sandy Lowland	2, 500–4, 000
Loamy Upland	2, 500–5, 000
Clay Upland	1, 500–5, 000
Sandy	2, 500–5, 000
Sands	3, 000–4, 500
Breaks	2, 000–3, 000

Management of Windbreaks

Republic County has no native forests or large areas of woodland, though there are open stands of hardwoods bordering streams. The trees seldom grow large enough to be of commercial value, but they are used for fuel, fenceposts, and wildlife food and cover.

The greatest use of trees and shrubs in the county is in windbreaks, which generally are around farmsteads. Native trees and shrubs that can be planted in windbreaks are bur oak, green ash, black walnut, hackberry, cottonwood, wild plum, and chokecherry. Any of these trees or shrubs can be put in windbreaks made up mostly of imported trees and shrubs.

Windbreaks require careful planning and special management, and they should be shaped to fit its particular area. The trees and shrubs should be selected according to their suitability for the different kinds of soils, and they should be planted in an area that has been cleared of vegetation. Cultivation is needed to keep out weeds. The young trees need protection from fire, livestock, insects, rabbits, and rodents.

Windbreak suitability groups

The soils of Republic County have been placed in four windbreak suitability groups according to their suitability for trees and shrubs. The suitability of each group for named species is rated in table 3. The four groups are Loamy Lowland, Sandy Lowland, Loamy Upland, and Shallow Upland. The Loamy Upland and the Loamy Lowland groups consist of medium-textured to fine-textured soils, and the Shallow Upland group consists of medium-textured soils. Moderately coarse textured to coarse textured soils make up the Sandy Lowland group. Each windbreak group consists of soils that are suitable for about the same kinds of trees and shrubs, that require similar management, and that provide about the same chance of survival and rate of growth. The soils in each group are listed in the "Guide to Mapping Units" at the back of this survey and are described in the section "Descriptions of the Soils."

Wildlife Management [2]

Soils influence wildlife, primarily through the vegetation they produce. The carrying capacity of an area for wildlife is largely determined by the kind, amount, and distribution of this vegetation. Fertile soils are capable of producing greater numbers of wildlife than less fertile soils, and waters that drain from fertile soils generally produce more fish than waters that drain from infertile soils.

Soils that tend to be impervious are suitable for the construction of ponds for fish. Swampy and marshy areas lend themselves to the development of aquatic and semiaquatic habitat for waterfowl and for some species of furbearers.

Topography affects wildlife, primarily through its influence on the way land is used. Where the topography is rolling and rough, many areas generally have an irregular shape and are difficult to farm or to fence for livestock. In these areas the undisturbed vegetation is valuable to wildlife, and other areas can be developed to provide additional wildlife habitat.

[2] By C. V. BOHART, conservation biologist, Soil Conservation Service, Lincoln, Nebr.

TABLE 3.—*Suitability of trees and shrubs for planting windbreaks* [1]

Trees and shrubs	Windbreak suitability groups			
	1. Loamy Lowland	2. Sandy Lowland	3. Loamy Upland	4. Shallow Upland
Shrubs:				
Fragrant sumac	Excellent	Excellent	Excellent	Good.
African tamarisk	Excellent	Excellent	Excellent	Good.
Common lilac	Excellent	Excellent	Good	Fair.
Wild plum	Excellent	Excellent	Good	Fair.
Multiflora rose	Fair	Fair	Not suitable	Not suitable.
Intermediate trees:				
Osage-orange	Excellent	Excellent	Excellent	Good.
Russian-mulberry	Excellent	Excellent	Excellent	Not suitable.
Russian-olive	Excellent	Excellent	Excellent	Good.
Tall trees:				
Siberian elm	Excellent	Excellent	Excellent	Good.
Bur oak	Excellent	Excellent	Good	Fair.
Green ash	Excellent	Excellent	Good	Not suitable.
Honeylocust	Excellent	Excellent	Excellent	Good.
Cottonwood	Good	Excellent	Fair	Not suitable.
Black walnut	Good	Fair	Fair	Not suitable.
Conifers:				
Eastern redcedar	Excellent	Excellent	Excellent	Good.
Western redcedar	Good	Excellent	Excellent	Good.
Austrian pine	Excellent	Excellent	Excellent	Good.
Ponderosa pine	Good	Good	Excellent	Good.

[1] Table prepared by F. D. ABBOTT, State soil conservationist, Soil Conservation Service.

The characteristics of the soils and the topography were considered in preparing table 4. That table shows the potential of the soil associations in the county for producing food and different kinds of cover or habitat for the more important species. The soil associations are described in the section "General Soil Map;" and the location of each is shown on the general soil map at the back of this survey. A detailed description of the individual soils in each association is given in the section "Descriptions of the Soils." Information about the use and management of the soils and about the kinds of vegetation the soils can produce are in other parts of this section "Use and Management of Soils."

The species of wildlife have changed since the county was first settled. Once there were buffalo, elk, and antelope, but deer are the only hoofed mammals that remain. Wild turkey and wolves are also no longer found. Deer are increasing in number because they have adapted well to the change in land use from virgin prairie to cultivated cropland. Among the smaller animals found in a desirable habitat of the county are raccoon, opossum, weasel, mink, muskrat, coyote, skunk, and cottontail rabbit.

Many different kinds of birds make the county their home. Waterfowl and shore birds use the Republican River and farm ponds during their annual migrations in fall and spring. Birds that require woody habitat are found mainly along streams and in windbreaks around farmsteads. Pheasant and bobwhite quail are important in the county.

Fish are found primarily in the Republican River and in farm and ranch ponds that were constructed for erosion control and for watering livestock. Most important are largemouth black bass, bluegill, channel catfish, and flathead catfish.

The use of soils for farming has many effects on wildlife because of the cover of vegetation it creates or removes. Where grassland is converted to cropland, some kinds of wildlife lose their protective cover. In turn, an improved supply of food and new types of cover are made available to other species.

In the early days, wildlife was an important source of food. Also, both the meat and pelts provided a source of cash income. Wildlife continues to be important, particularly for the recreational opportunities it provides for fishing and hunting. In addition, many species are beneficial because they help control undesirable insects and rodents.

Developing a specific habitat for wildlife requires that the vegetative cover is the kind that the soils can produce and that it is properly located. On-site technical assistance in planning developments for wildlife and in determining which species of vegetation to plant can be obtained from the office of the Soil Conservation Service that serves Republic County. Additional information and assistance can be obtained from the Bureau of Sports, Fisheries, and Wildlife, and from the Kansas Forestry, Fish and Game Commission.

Engineering Uses of Soils [3]

In this subsection the systems of engineering soil classification are described, engineering properties of soils

[3] H. Y. CORT and F. C. KENSEY, engineers in the Soil Conservation Service, assisted C. H. Atkinson, soil scientist, in preparation of this subsection.

TABLE 4.—*Potential of the soil associations for providing habitats required by some of the more important kinds of wildlife*

Soil association	Species	Potential for producing, for species of wildlife named—			
		Woody cover	Herbaceous cover	Aquatic habitat	Food
Crete-Butler-Hastings.	Pheasant	Very good	Very good		Very good.
	Quail	Fair	Good		Good.
	Waterfowl			Fair	Fair.
	Cottontail rabbit	Fair	Good		Fair.
	Dove	Good	Good		Good.
Hastings-Crete-Geary.	Pheasant	Very good	Very good		Good.
	Quail	Good	Very good		Good.
	Waterfowl			Fair	
	Cottontail rabbit	Good	Good		Good.
	Dove	Good	Good		Good.
	Deer	Fair	Good		Fair.
	Fish			Good	
Kipson-Tully-Crete.	Pheasant	Fair	Good		Fair.
	Quail	Fair	Fair		Fair.
	Cottontail rabbit	Fair	Fair		Fair.
	Dove	Fair	Fair		Fair.
	Deer	Fair	Fair		Fair.
	Fish			Very good	
Lancaster-Hedville-Crete.	Pheasant	Fair	Very good		Good.
	Quail	Good	Very good		Good.
	Cottontail rabbit	Good	Good		Good.
	Dove	Good	Good		Good.
	Deer	Good	Good		Good.
	Fish			Good	
Muir-Carr-Humbarger.	Quail	Very good	Very good		Very good.
	Cottontail rabbit	Very good	Very good		Very good.
	Dove	Good	Good		Good.
	Deer	Very good	Very good		Very good.
	Squirrel	Good	Good		Good.
	Furbearers	Good	Good		Good.
	Fish			Very good	
	Pheasant	Fair	Fair		Very good.

are estimated, and the suitability of soils for construction is rated. The soil properties that most influence design, construction, and maintenance of engineering structures are permeability to water, shear strength, compaction characteristics, soil drainage, shrink-swell characteristics, grain size, plasticity, and reaction. Depth to water table, depth to bedrock, and topography are also important.

The information in this survey can be used to—

1. Make soil and land use studies that will aid in selecting and developing industrial, business, residential, and recreational sites.
2. Make preliminary estimates of the engineering properties of soils that will help in the planning of agricultural drainage systems, farm ponds, terraces, waterways, dikes, diversion terraces, and irrigation systems.
3. Make preliminary evaluations of soil and ground conditions that will aid in selecting locations for highways, airports, pipelines, and cables and in planning detailed investigations at the selected location.
4. Locate probable sources of gravel and other construction materials.
5. Correlate performance of engineering structures with soil mapping units, and thus develop information that will be useful in maintaining the structures.
6. Determine the suitability of soil mapping units for cross-country movement of vehicles and construction equipment.
7. Supplement information obtained from other published maps, reports, and aerial photographs for the purpose of making maps and reports that will be more useful to engineers.
8. Develop other preliminary estimates for construction purposes pertinent to the particular area.

It is not intended that this survey will eliminate the need for on-site sampling and testing of sites for design and construction of specific engineering works and uses. It should be used only in planning more detailed field surveys to determine the condition of the soil, in place, at the site of the proposed engineering construction.

Although the detailed soil map and the tables serve as a guide for evaluating most soils, a detailed investigation at the site of the proposed construction is needed

because as much as 15 percent of an area designated as a specific soil on the map may consist of areas of other soils too small to be shown on the published map. By comparing the soil description with the result of investigations at the site, the presence of an included soil can usually be determined.

Some of the terms used by the soil scientists may not be familiar to the engineer, and some terms may have a special meaning in soil science. Several of these terms are defined in the Glossary at the back of this survey.

Engineering classification systems

The soil scientists of the U.S. Department of Agriculture (USDA) classify soils according to texture (*2*).[4] This system is useful only as the initial step for making engineering classifications of soils (*11*). The engineering properties of a soil must be determined or estimated after the textural classifications have been made. Two systems are used by engineers for classifying soils. These are the systems used by the American Association of State Highway Officials (AASHO) (*1*) and the Unified system developed by the Corps of Engineers, U.S. Army (*13*). These systems are explained briefly in the following paragraphs. The explanations are taken largely from the PCA Soil Primer (*7*).

AASHO classification system.—The AASHO system of classifying soils is based on actual performance of material used as a base for roads and highways. In this system all the soils are classified in seven basic groups. The materials that are most suitable for road subgrade are classed as A–1, and the soils least suitable are classed as A–7. Within fairly broad limits, all soil materials are classified numerically between these two extremes, according to their load-carrying ability. Three of the seven basic groups may be further divided into subgroups to designate variations within a group.

In the AASHO system, the soil materials may be placed in the following general groups: (1) Granular materials, in which 35 percent or less of the material passes a No. 200 sieve; and (2) silt-clay materials, in which more than 35 percent passes a No. 200 sieve. The silty part of the silt-clay material has a plasticity index of 10 or less, and the clayey material has a plasticity index greater than 10. The plasticity index is the numerical difference between the liquid limit and the plastic limit. The liquid limit is the moisture content, expressed in percentage of the ovendry weight, at which the soil material passes from a plastic to a liquid state. The plastic limit is the moisture content, expressed in percentage of the ovendry weight, at which the soil material passes from a semisolid to a plastic state.

Unified classification system.—In the Unified system, the soils are grouped on the basis of their texture and plasticity, as well as on their performance when used in engineering structures. The soil materials are identified as coarse grained, gravel (G) and sand (S); fine grained, silt (M) and clay (C); and highly organic (Pt). No highly organic soils were mapped in this county.

Under the Unified system, clean sands are identified by the symbols SW or SP; sands with fines of silt and clay are identified by the symbols SM and SC; silt and clay that have a low liquid limit are identified by the symbols ML and CL; and silt and clay that have a high liquid limit are identified by the symbols MH and CH.

On the basis of visual field inspection, an engineer can make an approximate classification of soils in the field. For exact classification, complete analysis of laboratory data is needed. Field classifications are useful for planning more detailed analyses at the site of construction.

Engineering properties of the soils

Table 5 gives the estimated U.S. Department of Agriculture textural classification and the estimated AASHO and Unified engineering classifications of the soils in the county. In addition, grain size percentages, permeability, available water capacity, and shrink-swell potential are estimated. Because Breaks-Alluvial land complex, Rough broken land, and Wet alluvial land are variable, these land types are not listed in table 5.

The data given in table 5 are based on the results of analysis made by the Kansas State Highway Commission; on the results of field tests at construction sites; and on information in other parts of the survey, particularly in the section "Descriptions of the Soils."

The columns that show percentage passing sieves of various sizes indicate the relative amounts of coarse-grained and fine-grained materials. The percentage passing the No. 200 sieve is the fine-grained fraction of the material. This information is based on analyses of similar soils supplied by the Kansas State Highway Commission and on the average analysis of textural classes, as modified by experience gained through fieldwork.

Permeability is the ability of the soil to transmit water or air. Field tests that measure the rate at which water percolates through the soil were made on most of the soils used for crops in the county. The information obtained from these tests was used as a basis for estimating the permeability of similar soils. In table 5 permeability is in inches per hour and is the rate that water moves through an undisturbed soil. Except for the Sarpy soils, all of the soils have moderately slow to moderate permeability. The Sarpy soils have rapid permeability.

The available water capacity refers to the difference between the amount of moisture in a soil at field capacity and the amount held at the permanent wilting point. This water is in a form that is readily available to plants. Most of the soils in the county contain so much fine material that their available water capacity is moderate to high. The Eudora, Carr, and Kenesaw are deep soils in the moderate textural range. The Sarpy, Kipson, and Hedville soils have the lowest available water capacity.

The rating for shrink-swell potential indicates the volume change of the soil when its content of moisture changes. Soils that have a high percentage of fine material, particularly of clay, generally have a higher shrink-swell potential than other soils. To be useful as core or base materials, soils with a high shrink-swell potential need to be protected from moisture changes. Geary silty clay loam has high shrink-swell potential in the upper part of its profile. The Ortello, Carr, and Sarpy soils have the lowest shrink-swell potential of the soils in the county.

[4] Italic numbers in parentheses refer to Literature Cited, p. 60.

TABLE 5.—*Estimated physical properties of soils*

Soils and map symbols	Depth from surface	Classification			Percentage passing sieve—			Permeability	Available water capacity	Shrink-swell potential
		USDA	Unified	AASHO	No. 4 (4.7 mm.)	No. 10 (2.0 mm.)	No. 200 (0.074 mm.)			
	Inches							*Inches per hour*	*Inches per inch of soil*	
Butler (Bu).	0–10	Silt loam	ML, CL	A–4, A–6	100	100	90–100	0. 2–0. 5	0. 19	Moderate.
	10–40	Silty clay	CH	A–7	100	100	90–100	0. 05–0. 2	. 19	High.
	40–60	Silty clay loam.	CL	A–6, A–7	100	100	85–95	0. 2–0. 5	. 19	Moderate.
Carr (Ca).	0–48	Fine sandy loam.	SM, ML	A–4	100	100	40–55	0. 5–1. 0	. 13	Low.
	48–60	Sand	SP, SP–SM.	A–3	100	90–95	0–10	5. 0+	. 04	Low.
Crete:										
Silt loam (Ce, Cf).	0–10	Silt loam	CL	A–6	100	100	90–100	0. 2–0. 5	. 19	Moderate.
Silty clay loam (Ch).	10–36	Silty clay	CH	A–7	100	100	90–100	0. 05–0. 2	. 19	High.
	36–60	Silty clay loam.	CL	A–6, A–7	100	100	85–95	0. 2–0. 5	. 19	Moderate.
Silty clay loam, eroded (Cr).	0–7	Silty clay loam.	CH	A–7	100	100	90–100	0. 05–0. 2	. 19	High.
	7–30	Silty clay	CH	A–7	100	100	90–100	0. 05–0. 2	. 19	High.
	30–60	Silty clay loam.	CL	A–6, A–7	100	100	85–95	0. 2–0. 5	. 19	Moderate.
Detroit (Dt).	0–12	Silty clay loam.	CL	A–6, A–7	100	100	90–100	0. 2–0. 5	. 19	Moderate.
	12–48	Silty clay	CH	A–7	100	100	90–100	0. 05–0. 2	. 19	High.
	48–60	Silty clay loam.	CL	A–7	100	100	90–100	0. 2–0. 5	. 19	High.
Englund (Ea).	0–10	Silty clay loam.	CL	A–6, A–7	100	100	90–100	0. 2–0. 5	. 19	Moderate.
	10–36	Silty clay	CH	A–7	100	100	90–100	0. 05–0. 2	. 19	High.
	36–48	Silty clay loam.	CL	A–6, A–7	100	100	85–95	0. 2–0. 5	. 19	Moderate.
Eudora:										
Loam, 0 to 2 percent slopes (Ed).	0–36	Loam	ML	A–4	100	100	70–85	0. 5–1. 0	. 17	Low.
	36–48	Fine sandy loam.	ML	A–4	100	95–100	55–70	0. 5–1. 0	. 13	Low.
	48–60	Silt loam to clay loam.	ML–CL	A–4, A–6	100	100	85–95	0. 2–0. 5	. 19	Moderate.
Loam, 2 to 8 percent slopes (Eu).	0–8	Loam	ML	A–4	100	100	70–85	0. 5–1. 0	. 17	Low.
	8–36	Fine sandy loam.	ML	A–4	100	95–100	55–70	0. 5–1. 0	. 13	Low.
	36–60	Silt loam to clay loam.	ML–CL	A–4, A–6	100	100	80–95	0. 2–0. 5	. 19	Moderate.
Geary:										
Silt loam (Gc). (For properties of the Crete soil in mapping unit Gc, refer to Crete silt loam.)	0–10	Silt loam	ML	A–4	95–100	95–100	90–100	0. 2–0. 5	. 19	Low.
	10–48	Silty clay loam.	CL	A–6, A–7	95–100	95–100	90–100	0. 05–0. 2	. 19	High.
	48–60	Clay loam	ML–CL	A–6	95–100	95–100	75–90	0. 2–0. 5	. 19	Moderate.
Silty clay loam (Gr). (For properties of the Crete soil in mapping unit Gr, refer to Crete silty clay loam, eroded.)	0–7	Silty clay loam.	CL	A–6, A–7	95–100	95–100	90–100	0. 05–0. 2	. 19	High.
	7–40	Silty clay loam.	CL	A–6, A–7	95–100	95–100	90–100	0. 05–0. 2	. 19	High.
	40–60	Clay loam	ML	A–6	95–100	95–100	75–90	0. 02–0. 5	. 19	Moderate.

TABLE 5.—*Estimated physical properties of soils*—Continued

Soils and map symbols	Depth from surface	Classification			Percentage passing sieve—			Permeability	Available water capacity	Shrink-swell potential
		USDA	Unified	AASHO	No. 4 (4.7 mm.)	No. 10 (2.0 mm.)	No. 200 (0.074 mm.)			
Hastings:	*Inches*							*Inches per hour*	*Inches per inch of soil*	
Silt loam (Ha, Hb, Hc).	0–12	Silt loam	ML-CL	A–4, A–6	100	100	90–100	0. 2–0. 5	0. 19	Moderate.
	12–48	Silty clay loam.	CL	A–7	100	100	90–100	0. 05–0. 2	. 19	High.
	48–60	Silty clay loam.	CL	A–6, A–7	100	100	85–95	0. 2–0. 5	. 19	Moderate.
Silty clay loam (Hd, He, Hp).	0–6	Silty clay loam.	CL	A–6, A–7	100	100	90–100	0. 5–0. 2	. 19	Moderate.
(For properties of the Hobbs soil in mapping unit Hp, refer to the Hobbs series.)	6–36	Silty clay loam.	CL	A–7	100	100	90–100	0. 05–0. 2	. 19	High.
	36–60	Silty clay loam.	CL	A–6, A–7	100	100	85–95	0. 2–0. 5	. 19	Moderate.
Fine sandy loam (Hf, Ho).	0–12	Fine sandy loam.	ML	A–4	100	95–100	40–55	0. 5–1. 0	. 13	Low.
(For properties of the Ortello soil in mapping units Hf and Ho, refer to the Ortello series.)	12–24	Clay loam	CL, CH	A–6, A–7	100	100	75–90	0. 05–0. 2	. 19	High.
	24–48	Silty clay loam.	CL	A–7	100	100	90–100	0. 05–0. 2	. 19	High.
	48–60	Silty clay loam.	CL	A–6, A–7	100	100	85–95	0. 2–0. 5	. 19	Moderate.
Hedville (Lh).	0–14	Gravelly to stony loam	SM, ML	A–4	70–85	55–75	35–60	0. 2–0. 5	. 19	Low.
(For properties of the Lancaster soil in mapping unit Lh, refer to the Lancaster series.)	14	Sandstone and shale.								
Hobbs (Hp, Hs).	0–18	Silt loam	ML	A–4	100	100	90–100	0. 2–0. 5	. 18	Low.
	18–48	Silty clay loam.	CL	A–6, A–7	100	100	90–100	0. 2–0. 5	. 18	Moderate.
	48–60	Silty clay loam.	CL	A–7	100	100	90–100	0. 05–0. 2	. 18	High.
Humbarger:										
Clay loam (Ht).	0–7	Clay loam	CL	A–6	100	100	80–90	0. 05–0. 2	. 19	Moderate.
	7–36	Silty clay loam.	CL	A–6, A–7	100	100	90–100	0. 05–0. 2	. 19	High.
	36–48	Silt loam	ML	A–4, A–6	100	100	90–100	0. 2–0. 5	. 19	Moderate.
	48–60	Sand	SP, SP–SM	A–3	100	95–100	0–10	5. 0+	. 04	Low.
Loam (Hu).	0–7	Loam	ML	A–4	100	100	70–85	0. 2–0. 5	. 19	Low.
	7–48	Silt loam	ML-CL	A–4, A–6	100	100	80–90	0. 2–0. 5	. 19	Moderate.
	48–60	Sand	SP	A–3	100	95–100	0–5	5. 0+	. 04	Low.
Kenesaw (Ke, Kn).	0–6	Silt loam	ML	A–4	100	100	80–95	0. 2–0. 5	. 19	Low.
	6–60	Silt loam	ML	A–4, A–6	100	100	80–95	0. 2–0. 5	. 19	Moderate.
Kipson (Kp).	0–15	Stony loam	SM	A–2, A–4	70–80	55–70	30–50	0. 2–0. 5	. 19	Moderate.
	10–15	Stony silt loam.	SM	A–2	70	55	35	0. 2–0. 5	. 19	Low.
	15	Limestone and shale.								
Lancaster (La, Lc, Lh).	0–10	Loam	ML	A–4	95–100	95–100	75–90	0. 2–0. 5	. 19	Low.
	10–48	Clay loam	CL	A–6, A–7	95–100	95–100	80–90	0. 05–0. 2	. 19	Moderate.
	48–60	Gravelly loam.	ML	A–4	90–95	85–90	60–75	0. 2–0. 5	. 17	Low.
	60	Sandstone and shale.								

TABLE 5.—*Estimated physical properties of soils*—Continued

Soils and map symbols	Depth from surface	Classification			Percentage passing sieve—			Permeability	Available water capacity	Shrink-swell potential
		USDA	Unified	AASHO	No. 4 (4.7 mm.)	No. 10 (2.0 mm.)	No. 200 (0.074 mm.)			
	Inches							*Inches per hour*	*Inches per inch of soil*	
Muir (Mr, Mu).	0–20	Silt loam	ML	A–4	95–100	95–100	85–100	0. 2–0. 5	0. 19	Low.
	20–40	Silty clay loam.	CL	A–6	95–100	95–100	90–100	0. 2–0. 5	. 19	Moderate.
	40–60	Loam	ML	A–4	95–100	95–100	70–85	0. 2–0. 5	. 19	Low.
Ortello. (Mapped only with Hastings fine sandy loam in this county.)	0–24	Fine sandy loam.	SM, ML	A–4	100	95–100	40–55	0. 5–1. 0	. 13	Low.
	24–40	Loam to fine sandy loam.	ML	A–4	100	100	75–85	0. 5–1. 0	. 17	Low.
	40–60	Sandy loam	ML	A–4	100	95–100	55–75	0. 5–1. 0	. 13	Low.
Sarpy (Sa, Sd).	0–20	Loamy sand or loamy fine sand.	SM	A–2, A–4	95–100	95–100	20–40	1. 0–2. 0	. 06	Low.
	20–60	Sand	SP, SP–SM	A–3	95–100	95–100	0–10	2. 0–5. 0	. 04	Low.
Tully (Tu, Ty).	0–12	Silty clay loam.	ML, CL	A–4, A–6	95–100	95–100	90–100	0. 2–0. 5	. 19	Moderate.
	12–48	Silty clay loam.	CL	A–7	95–100	95–100	90–100	0. 05–0. 2	. 19	High.
	48–60	Silty clay loam.	CL	A–6	95–100	95–100	90–100	0. 2–0. 5	. 19	Moderate.

Engineering interpretations

The suitability of the soils as a source of topsoil, road fill, and subgrade is given in table 6. Table 6 also names the soil features that affect the location of highways and the construction of dikes and levees, farm ponds, drainage and irrigation structures, terraces and diversions, and waterways. Breaks-Alluvial land complex, Rough broken land, and Wet alluvial land are not listed in table 6, because their material is so variable that meaningful interpretations cannot be made.

The surface layer of most soils in the county is good for topsoil if the soils have not been materially eroded. Carr and Sarpy soils are the least desirable in the county for topsoil. Most of the soils are good for road fill, but the soils that have high shrink-swell potential are only fair. The Carr and Sarpy soils are good sources of subgrade material if they are confined, but the rest of the soils in the county are only fair or are poor.

The rest of table 6 points out soil properties that are favorable or unfavorable if the soils are used for specified engineering structures or practices. Naming unfavorable features for a specified use does not necessarily mean the soil cannot be used for that purpose; practices may be followed that counteract the effects of the unfavorable features.

Some engineering uses are not included in table 6. Usable sand and gravel lie in isolated pockets beneath the Geary soils. Also, the deep silty loess beneath the Kenesaw soils can be a part of certain blacktop mixtures used on roads. Under the Lancaster-Hedville complex are partly weathered sandstone and sandy shale that can be used for road fill and road surfacing. The limestone and shale beneath the Kipson soils can be used for the same purposes.

Formation and Classification of Soils

This section consists of two main parts. The first part tells how the factors of soil formation affected the formation of soils in Republic County. In the second part the system of soil classification currently used is explained, and each soil series in the county is placed in classes of this system and in the great soil groups and soil orders of the system adapted in 1938.

Factors of Soil Formation

Soil is produced by soil-forming processes acting on the soil materials deposited or accumulated by natural forces. The characteristics of the soil at any given point are determined by (1) the physical and mineralogical composition of the parent material; (2) the climate under which the soil material has accumulated and existed since accumulation; (3) the plant and animal life on and in the soil; (4) the relief, or lay of the land; and (5) the length of time the forces of soil formation have acted on the soil material.

TABLE 6.—*Engineering*

Soil series and map symbols	Suitability as source of—			Soil features affecting engineering practices—	
	Topsoil	Road fill [1]	Subgrade [1]	Highway location [1]	Dikes and levees
Butler (Bu)	Fair in surface layer.	Fair	Poor	No undesirable features.	Subject to cracking when dry; slopes moderately erosive.
Carr (Ca)	Fair in surface layer.	Good in upper 2 to 4 feet; good in substratum if confined.	Good; good if confined.	High erodibility; subject to flooding.	Erosive slopes; pervious substratum.
Crete (Ce, Cf, Ch, Cr)	Good in surface layer in uneroded areas.	Fair	Poor	No undesirable features.	Subject to cracking when dry; slopes moderately erosive.
Detroit (Dt)	Good in surface layer.	Fair	Poor	No undesirable features.	Subject to cracking when dry; slopes moderately erosive.
Englund (Ea)	Fair in surface layer.	Fair	Poor	No undesirable features.	Subject to cracking when dry; slopes moderately erosive.
Eudora (Ed, Eu)	Good	Good	Fair	No undesirable features.	Moderate erodibility and susceptibility to piping; poor stability.
Geary (Gc, Gr) (For interpretations of the Crete soil in mapping units Gc and Gr, refer to the Crete series.)	Good in surface layer.	Fair	Poor	Moderately slow permeability; overlain by Peorian loess; seepage at contact.	Erosive slopes
Hastings (Ha, Hb, Hc, Hd, He, Hf, Ho, Hp). (For interpretations of the Hobbs soil in mapping unit Hp, and of the Ortello soil in units Ho and Hf, refer to the Hobbs and Ortello series, respectively.)	Good in surface layer in uneroded areas; fair in upper subsoil.	Fair	Poor	No undesirable features.	Erosive slopes
Hedville (Lh) (For interpretations of the Lancaster soil in mapping unit Lh, refer to the Lancaster series.)	Poor	Good	Poor	Shallow over bedrock.	Shallow over porous rock; erosive slopes.
Hobbs (Hs, Hp)	Good in surface layer and subsoil.	Good	Poor	Subject to flooding.	Pervious substratum in places.

See footnote at end of table.

interpretations

Soil features affecting engineering practices—Continued

Farm ponds		Agricultural drainage	Irrigation	Terraces and diversions	Waterways
Reservoir area	Embankment				
Very slow permeability; may be used as dugouts.	Impervious soil when compacted; fair to poor stability.	High plasticity in subsoil; very slow permeability; slow runoff.	Very slow permeability; in broad depressions.	Nearly level; plastic subsoil.	Nearly level; plastic subsoil.
Moderate to high seepage in substratum.	Erosive slopes; subject to piping.	Slow runoff; good internal drainage.	Moderate susceptibility to wind erosion; some areas shallow over sand; occasional flooding.	Nearly level; susceptible to wind erosion.	Moderate susceptibility to wind erosion.
Slow permeability; high shrink-swell potential.	Slow permeability; low shear strength; high shrink-swell potential; good core material.	Generally good drainage.	Slow permeability; moderate to high plasticity and shrink-swell potential.	Moderate to high shrink-swell potential; erosive slopes.	High plasticity in subsoil.
Moderately slow permeability; high shrink-swell potential.	High shrink-swell potential; low shear strength.	Moderately slow permeability; occasional flooding.	High water-holding capacity; moderate to high plasticity and shrink-swell potential; some depressions.	High shrink-swell potential; nearly level; occasional flooding.	High plasticity in subsoil; nearly level; occasional flooding.
Moderately slow permeability; high shrink-swell potential; about 4 feet to shale.	Low shear strength; high shrink-swell potential; good core material.	Generally good drainage.	Moderately slow permeability; high plasticity in subsoil; about 4 feet to shale.	High shrink-swell potential; erosive slopes.	High plasticity in subsoil.
Moderate erodibility, permeability, and susceptibility to piping.	Moderate erodibility, susceptibility to piping, and permeability; poor compaction; low shear strength and stability.	Good drainage	Silty substratum retards leaching; moderate susceptibility to wind erosion; minor flooding.	Moderate susceptibility to wind erosion; nearly level.	Moderate susceptibility to wind erosion; nearly level.
Moderately slow permeability.	Low to moderate shear strength, stability, and compaction.	Good drainage	Deep soil; rolling; high water-holding capacity; erosive slopes.	Rolling soil; erosive slopes.	Rolling soil; erosive slopes; good fertility.
Moderately slow permeability.	Low to moderate shear strength, stability, and compaction.	Good drainage	Deep soil; high water-holding capacity; erosive slopes.	Nearly level to rolling; erosive slopes.	Nearly level to rolling soil; erosive slopes.
Average depth to unweathered porous rock is less than 2 feet.	Shallow over porous rock.	Excessive drainage.	Shallow soil; rolling steep; low water-holding capacity.	Rolling to steep; rocky; erosive, shallow soil.	Erosive, shallow soil; rocky; rolling to steep.
Pervious substratum of varying thickness in places.	High compressibility, fair stability and compaction.	Good drainage but subject to flooding.	First bottom subject to frequent flooding.	Nearly level; frequent flooding.	Nearly level; frequent flooding.

TABLE 6.—*Engineering*

Soil series and map symbols	Suitability as source of—			Soil features affecting engineering practices—	
	Topsoil	Road fill [1]	Subgrade [1]	Highway location [1]	Dikes and levees
Humbarger (Ht, Hu)	Good in surface layer and subsoil.	Good	Poor in the clay loam (Ht) and fair in the loam (Hu).	Subject to flooding.	Pervious substratum.
Kenesaw (Ke, Kn)	Good	Good	Fair	No undesirable features.	Moderate erodibility; poor stability and compaction; moderate susceptibility to piping.
Kipson (Kp)	Very poor	Good	Poor	Shallow over bedrock.	Borrow material is limited; stony or shaly.
Lancaster (La, Lc, Lh)	Good in surface layer.	Good	Poor	No undesirable features.	Fair stability; erosive slopes.
Muir (Mr, Mu)	Very good	Good	Fair	No undesirable features.	Subject to piping; erosive slopes.
Ortello (Hf, Ho)	Good	Good	Fair to good	No undesirable features.	Subject to piping; erosive slopes.
Sarpy (Sa, Sd)	Fair in surface layer.	Good, if confined.	Good, if confined.	High erodibility; subject to flooding.	Moderately rapid permeability; moderate susceptibility to wind erosion.
Tully (Tu, Ty)	Good in surface layer.	Fair	Poor	No undesirable features.	Slopes moderately erosive.

[1] Ratings estimated with the assistance of C. W. Heckathorn, field soils engineer, and Herbert E. Worley, soils research engineer,

interpretations—Continued

Soil features affecting engineering practices—Continued					
Farm ponds		Agricultural drainage	Irrigation	Terraces and diversions	Waterways
Reservoir area	Embankment				
Pervious substratum.	Low to moderate shear strength, stability, and compaction; high susceptibility to piping in surface layer.	Moderately good drainage; occasional flooding.	Some areas have slow permeability, some areas are shallow over sand, occasional flooding.	Nearly level; occasional flooding.	Some areas are shallow over sand; nearly level; occasional flooding.
Moderate susceptibility to piping; moderate erodibility.	Low shear strength; poor stability and compaction; moderate erodibility and susceptibility to piping.	Good drainage	Steep slopes	Poor stability; moderate erodibility.	Moderate erodibility.
Average depth to unweathered rock is 24 inches; moderate permeability	Average depth of soil and weathered rock over fractured rock is 24 inches.	Good drainage	Shallow soil; rolling to steep.	Shallow over unweathered rock.	Shallow soil; rolling to steep.
Low to moderate seepage.	Low to moderate shear strength, stability, and compaction.	Good drainage	Average depth to bedrock is 44 to 60 inches.	Erosive slopes	Moderate fertility level.
Moderate permeability.	Low to moderate shear strength; poor to fair stability and compaction; high susceptibility to piping; moderate erodibility.	Good drainage	Deep soil; well drained; high water-holding capacity.	Nearly level	No undesirable features; nearly level.
Moderate permeability and susceptibility to piping.	Moderate erodibility, permeability, and susceptibility to piping.	Good drainage	Moderate permeability and susceptibility to soil leaching.	Erosive slopes	Erosive slopes.
Pervious substratum.	Poor resistance to piping; fair to poor stability.	Good drainage	Moderately rapid permeability; moderate susceptibility to wind erosion; low water retention.	Nearly level; occasional flooding.	Low water retention; moderate susceptibility to wind erosion.
Moderately slow permeability.	Low to moderate shear strength, stability, and compaction.	Good drainage	Moderate to high water-holding capacity; sloping.	Moderately erosive slopes.	Moderately erosive slopes.

Kansas State Highway Commission, in cooperation with the Bureau of Public Roads.

Climate and plant and animal life, chiefly plants, are active factors of soil formation. They act on the parent material that has accumulated and slowly change it into a natural body having genetically related horizons. The effects of climate and plant and animal life are conditioned by relief. The parent material also affects the kind of soil profile that is formed and in extreme cases may determine it almost entirely. Finally, time is needed for changing the parent material into a soil profile. It may be much or little, but some time is always required for soil horizon differentiation. Usually, a long time is required for the development of distinct horizons.

The factors of soil formation are so closely interrelated in their effects on the soil that few generalizations can be made regarding the effect of any one factor unless conditions are specified for the other four. Many of the processes of soil formation are not well known.

Parent material

The weathering of material placed by natural forces produces the parent material from which soils develop. In Republic County parent material has been formed by the weathering of bedrock or loose materials deposited by water or wind.

This parent material is changed into soil through the action of all interrelated soil-forming factors. The soil developed generally inherits some characteristics from the parent material, and the effect of these characteristics is shown by the physical and mineralogical composition of the soil. Partly because parent material is of different kinds, different kinds of soils formed in the county.

Rock formations that crop out in the county were formed during the Cretaceous period while this part of Kansas was under water. By the end of this period, the land was exposed to weathering processes and to geologic erosion. Later, during Pliocene and Pleistocene epochs, new soil material was deposited by water and wind, and the Republican River began to cut a valley south of the town of Republic (*4*).

The present soils in the county are the result of soil-forming processes slowly changing the parent material into soil. Geologic erosion has developed the drainage pattern and the forms of most of the slopes.

In Republic County the bedrock formed during the Cretaceous period is the source of parent material of four kinds of soils. The Kipson soils developed on the interbedded limestone and shale of the Greenhorn formation; the Hedville soils developed on sandstone; the Englund soils developed on soft shale; and the Lancaster soils developed on sandstone and shale of the Dakota formation. The Geary soils formed in silty material deposited during the Illinoian stage of the Pleistocene epoch.

The Butler, Crete, Hastings, Kenesaw, and other soils in the county developed in loess laid down in Early Wisconsin time. In small valleys of the hilly limestone section, the Tully soils developed from mixed soil material that washed from areas of loess and of limestone and shale.

After the last loessal deposition, the terraces and flood plains were formed when the streams cut into the valleys and deposited material. The deposits at terrace level are seldom flooded and are the parent material of the Muir, Detroit, and Eudora soils. Because the flood plains are still changed by cutting and deposition, the soil-forming processes have little chance to influence the formation of soils. On the flood plains are the Hobbs, Humbarger, Carr, and Sarpy soils.

Climate

Climate is one of the active factors in soil formation; it has both direct and an indirect influence. The amount and distribution of precipitation directly influence the formation of soil by causing the parent material to slowly weather and change into soil. An indirect influence is through the effect of climate on the plant and animal life on and in the soil. Where precipitation has been sufficient to maintain enough plant and animal life, the soils that develop have a dark-colored surface layer.

The continental climate of Republic County fluctuates from dry to moist subhumid. This fluctuation may be from year to year or in cycles that cover several years. During dry periods, precipitation and humidity may be well below normal and temperature above normal. In the wet periods, the precipitation and humidity are considerable above normal and the temperature is normal or below normal.

The soil profile is dried to varying depths during some dry periods, but it is dried throughout during other dry periods. When the weather changes to wet, the soil profile is slowly moistened and generally becomes so saturated that excess moisture penetrates the underlying material, or substratum. The presence of different kinds of concretions in the underlying material indicate the penetration of this excess moisture.

The alternate wetting and drying has been effective in the development of the soil profile because bases have been slightly leached from the surface horizon and even from the lower B horizon. This leaching has left the surface horizon slightly acid and the lower B horizon at least neutral. In mature soils a distinct structure and clay films are noticeable. More well-developed horizons develop in soils on gentle slopes than in soils on steeper slopes because more moisture penetrates the soils on the gentle slopes.

Weather records in Republic County show that the winters are short and cold, and the summers are long and hot. About 75 percent of the precipitation falls during the long growing season. The rainfall in the growing season has maintained the tall grass vegetation. The vegetation, in turn, has reduced erosion and the removal of bases and has added organic matter to the upper soil horizons.

Plants and animals

In Republic County the fluctuating, dry to moist, subhumid climate favored the growth of tall grasses. The original plant cover consisted mainly of big bluestem, little bluestem, indiangrass, switchgrass, Canada wildrye, prairie cordgrass, and some sandy land grasses. Scattered trees grew along most of the larger streams. Some valleys had a somewhat open stand of oak, ash, black walnut, hackberry, cottonwood, elm, and willows.

As the grass cover spread, it reduced geologic erosion and stabilized the soils. Under the grass cover, the soils developed a thick, dark-colored surface soil. Additional

organic matter that helped to darken the soil was added by the animal life on and in the soil. The fibrous roots of the grasses drew nutrients from the soil that encouraged a thick cover of vegetation. As the vegetation decayed plant nutrients were released and were carried into the soil by permeating moisture. Moderately leached, dark-colored, fertile soils have developed as a result of this growth-decay cycle operating in the fluctuating, subhumid climate.

Relief

Although climate and vegetation are the most active factors in changing soil material into soil, the relief, or lay of the land, modifies the change. Relief influences soil development, mainly by controlling the movement of water on the surface and into the soil. Partly because slopes are strong or steep, the Kipson and other thin soils developed on some of the oldest parent material in the county. Runoff is rapid on steep slopes, and much of the soil material is removed as fast as it forms. On the other hand, the terraces have broad areas where slope is nearly level to gentle and runoff is very slow. In these areas most of the precipitation penetrates the soil, and moderately well developed soils formed on some of the most immature soil materials. On soils formed in recent deposits of loess, the effect of the degree and shape of the slopes is most evident. The strongly developed Butler soils formed on slightly concave slopes, and the weakly developed Kenesaw soils formed on steep slopes. On the moderate slopes between these extremes are the moderately well developed Crete and Hastings soils.

Time

Time is required for the climate and vegetation to change the parent material into soil. On the flood plains, little time is allowed for soil development because soil material is continually deposited and removed. In a new deposit, the content of organic matter in the surface layer may differ from the content in the soil covered. Soils other than those on flood plains have reached varying degrees of development since their parent material has accumulated. The weak horizonation in the moderately developed soils on terraces indicates that they have been developing for less time than have some of the soils on uplands, but this general grouping is broad and is related to geologic time periods. In each group of soils the development of the soil profile is the result of the action of all of the closely interrelated soil-forming factors.

Classification of Soils

Soils are classified so that we may more easily remember their significant characteristics. Classification enables us to assemble knowledge about the soils, to see their relationships to one another and to the whole environment, and to develop principles that help us to understand their behavior and their response to manipulation. First through classification, and then through the use of soil maps, we can apply our knowledge of soils to specific fields and other tracts of land.

Thus, in classification soils are placed in narrow categories that are used in detailed soil surveys so that knowledge about soils can be organized and applied to farms, fields, and ranges; in engineering works; and in many other ways. They are placed in broad classes to facilitate study and comparison in large areas, such as countries and continents.

Two systems of classifying soils are now in general use in the United States. One of these is the 1938 system (*2*), with later revisions (*10*). The other, the current system, was placed in general use by the Soil Conservation Service in 1965. The reader who is interested in the current system should search the latest literature (*8*, *9*). In this survey some of the classes in the current system, and the orders and great soil groups of the older system, are given in table 7.

TABLE 7.—*Soil series classified according to the current system of classification and the 1938 system*

Series	Current classification [1]			1938 system	
	Family	Subgroup	Order	Great soil group	Order
Butler	Fine, montmorillonitic, mesic	Albic Argiustolls	Mollisols	Planosol	Intrazonal.
Carr	Coarse loamy, mixed, calcareous, mesic.	Cumulic Haplorthents	Entisols	Alluvial	Azonal.
Crete	Fine, montmorillonitic, mesic	Typic Argiustolls	Mollisols	Chernozem	Zonal.
Detroit	Fine, montmorillonitic, mesic	Cumulic Argiustolls	Mollisols	Chernozem	Zonal.
Englund	Fine, montmorillonitic, mesic	Typic Argiustolls	Mollisols	Chernozem	Zonal.
Eudora	Coarse silty, mixed, mesic	Typic Hapludolls	Mollisols	Alluvial	Azonal.
Geary	Fine silty, mixed, mesic	Typic Argiudolls	Mollisols	Brunizem	Zonal.
Hastings	Fine, montmorillonitic, mesic	Typic Argiustolls	Mollisols	Chernozem	Zonal.
Hedville	Loamy, mixed, mesic	Lithic Hapludolls	Mollisols	Lithosol	Azonal.
Hobbs	Fine silty, mixed, mesic	Cumulic Hapludolls	Mollisols	Alluvial	Azonal.
Humbarger	Fine loamy, mixed, mesic	Fluventic Haplustolls	Mollisols	Alluvial	Azonal.
Kenesaw	Fine silty, mixed, mesic	Typic Haplustolls	Mollisols	Chernozem	Zonal.
Kipson	Loamy, mixed, mesic, thin	Entic Haplustolls	Mollisols	Lithosol	Zonal.
Lancaster	Fine loamy, mixed, mesic	Typic Argiustolls	Mollisols	Brunizem	Zonal.
Muir	Fine silty, mixed, mesic	Cumulic Hapludolls	Mollisols	Brunizem	Zonal.
Ortello	Coarse loamy, mixed, mesic	Typic Haplustolls	Mollisols	Brunizem	Zonal.
Sarpy	Sandy, siliceous, nonacid, mesic	Cumulic Normipsamments	Entisols	Alluvial	Azonal.
Tully	Fine, montmorillonitic, mesic	Cumulic Argiustolls	Mollisols	Brunizem	Zonal.

[1] This classification is according to the system current in July 1965.

The current system of classification is still under study, and placement of some soil series in this system, particularly in families, may change as more precise information becomes available.

The classes in the current system are briefly defined in the paragraphs that follow. These definitions are followed by descriptions of each soil series in the county, which include a description of a profile representative of the series. Each soil mapped in the county is described in the section "Descriptions of the Soils."

ORDER: Ten soil orders are recognized in the current system. They are Entisols, Vertisols, Inceptisols, Aridisols, Mollisols, Spodosols, Alfisols, Ultisols, Oxisols, and Histosols. The properties used to differentiate the soil orders are generally those that tend to give broad climatic groupings of soils. Two exceptions are the Entisols and Histosols, which occur in many different climates. Table 7 shows the two soils orders in Republic County—Entisols and Mollisols.

SUBORDER: Each order is subdivided into suborders, primarily on the basis of those soil characteristics that seem to produce classes having the greatest genetic similarity. The suborders narrow the broad climate range permitted in the orders. The soil properties used to separate suborders mainly reflect either the presence or absence of waterlogging or the soil differences resulting from the climate or vegetation.

GREAT GROUPS: Soil suborders are separated into great groups on basis of uniformity in the kinds and sequence of major soil horizons and features. The horizons used to make separations are those in which clay, iron, or humus have accumulated or those that have pans interferring with growth of roots or movement of water. The features used are the self-mulching properties of clays, soil temperature, major differences in chemical composition (mainly calcium, magnesium, sodium, and potassium), and the like. The great group is not shown separately in table 7 because it is the last word in the name of the subgroup.

SUBGROUPS: Great groups are subdivided into subgroups, one representing the central (typic) segment of the groups and others, called intergrades, that have properties of one group and also one or more properties of another great group, suborder, or order. Subgroups may also be made in those instances where soil properties intergrade outside of the range of any other great group, suborder, or order. The names of subgroups are derived by placing one or more adjectives before the name of the great group. An example is Typic Argiustolls (a typical Argiustolls).

FAMILIES: Families are separated within a subgroup primarily on the basis of properties important to the growth of plants or behavior of soils used for engineering. Among the properties considered are texture, mineralogy, reaction, soil temperature, permeability, thickness of horizons, and consistence. An example of a family is the fine, montmorillonitic, mesic family of Typic Argiustolls.

BUTLER SERIES

The Butler series consists of deep, moderately well drained soils that developed in Peorian loess. These soils occupy slightly concave positions in very gently undulating relief. Runoff, internal drainage, and permeability are slow, and some areas are ponded after rains. These soils occur in small areas, mainly in the west-central and northeastern parts of the county.

Unlike the Crete soils, the Butler soils grade abruptly from the A1 horizon to the B2 and, in places, have gray-coated peds where the A and B horizons meet. The Butler soils have a grayer, more clayey B2 horizon and a thinner solum than the Hastings and Geary soils.

Profile of Butler silt loam, thin surface variant, in a cultivated field (500 feet north and 100 feet west of the southeast corner, sec. 20, T. 3 S., R. 5 W.):

Ap—0 to 9 inches, dark-gray (10YR 4/1) silt loam, very dark gray (10YR 3/1) when moist; moderate, fine, granular structure and massive; slightly hard when dry, friable when moist; slightly acid; abrupt, smooth boundary.

B21t—9 to 18 inches, dark-gray (10YR 4/1) silty clay, very dark grayish brown (10YR 3/2) when moist; moderate, medium, angular blocky structure; thick, dark-colored clay films; extremely hard when dry, very firm when moist; slightly acid; gradual, smooth boundary.

B22t—18 to 24 inches, gray (2.5Y 5/1) silty clay, dark gray (2.5Y 4/1) when moist; few, distinct, fine mottles of strong brown; moderate, medium, angular blocky structure; thick clay films; extremely hard when dry, very firm when moist; neutral; gradual, smooth boundary.

B3ca—24 to 38 inches, light brownish-gray (2.5Y 6/2) heavy silty clay loam, grayish brown (2.5Y 5/2) when moist; common, distinct, fine mottles of strong brown; moderate, medium and fine, angular blocky structure; moderately thick clay films; very hard when dry, firm when moist; mildly alkaline; numerous concretions of calcium carbonate; gradual, smooth boundary.

Cca—38 to 60 inches, light-gray (5Y 7/2) light silty clay loam, olive gray (5Y 5/2) when moist; common, distinct, medium mottles of strong brown; weak, medium and fine, subangular blocky structure; slightly hard when dry, friable when moist; calcareous; small, hard concretions and soft, white coatings of calcium carbonate.

The A1 horizon ranges from dark gray to dark grayish brown in color and from 5 to 12 inches in thickness. In some places in the A1 horizon, and at the boundary between the A and B horizons, the peds are gray or have gray coatings. An A2 horizon 1 inch thick occurs in places. In a few places the A horizon has thin platy structure in the lower 2 inches. In some areas a grayish-brown B2 horizon occurs beneath the surface layer. The solum generally ranges from 36 to 40 inches in thickness but, in places, is as thick as 48 inches.

CARR SERIES

The Carr series consists of nearly level to gently undulating, well-drained soils that developed in deposits of sandy loam on the flood plains along the Republican River. The Carr soils are highly stratified and are calcareous throughout the profile.

These soils have slow runoff and medium to rapid internal drainage. Permeability is moderate. The water table fluctuates between 3 and 12 feet and, during the growing season, is below 4 feet.

The Carr soils are more sandy and have a lighter colored A horizon than the Humbarger and Hobbs soils. The A horizon of the Carr soils is calcareous, and the AC horizon is sandy loam, but the A horizon of Sarpy soils is noncalcareous and the AC horizon is loamy sand.

The Carr soils are more frequently flooded and more stratified than the Eudora soils and have a lighter colored A horizon.

Profile of Carr fine sandy loam in a cultivated field (2,300 feet west and 50 feet north of the southeast corner of sec. 29, T. 4 S., R. 4 W.):

Ap—0 to 7 inches, light brownish-gray (10YR 6/2) fine sandy loam, dark grayish brown (10YR 4/2) when moist; very weak, fine, granular structure and massive; loose when dry, very friable when moist; calcareous; abrupt, smooth boundary.

AC—7 to 30 inches, light brownish-gray (10YR 6/2) fine sandy loam, grayish brown (10YR 5/2) when moist; stratified with lighter and darker colored, more sandy and clayey layers; weak, medium and fine, granular structure; soft when dry, very friable when moist; calcareous; gradual, smooth boundary.

C1—30 to 48 inches, light brownish-gray (10YR 6/2) fine sandy loam and loamy fine sand, grayish brown (10YR 5/2) when moist; stratified with lighter and darker colored, more sandy and clayey layers; weak, medium, granular structure and massive; soft when dry, very friable when moist; calcareous; clear, smooth boundary.

IIC2—48 to 60 inches, light-gray (10YR 7/2) loamy sand, pale brown (10YR 6/3) when moist; stratified with thin, dark-colored, clayey layers; single grain; calcareous.

The A horizon ranges from light brownish gray to dark grayish brown in color and generally from fine sandy loam to loam in texture. In some small areas the A horizon is fine sand or loamy sand. The highly stratified AC horizon normally is sandy loam and ranges from 12 to 24 inches in thickness. The C horizon ranges from fine sandy loam to loamy fine sand in texture and from 6 to 30 inches in thickness. In places the C horizon is streaked or spotted with strong brown. Below the surface layer, loose white sand, grayish clay loam, or dark-gray silty clay may occur at any depth. A IIC horizon of sand or sand and gravel occurs at a depth of 20 to more than 60 inches.

Crete Series

The Crete series consists of deep, well-drained soils that have medium to slow runoff, slow internal drainage, and moderately slow permeability. These soils developed in Peorian loess. They occur throughout the county in small to large areas and are nearly level to sloping or gently undulating. Figure 17 shows a profile of a Crete soil.

Unlike the Butler soils, the Crete soils grade gradually from the A1 horizon to the B2. Compared with the Geary, Hastings, and Tully soils, the Crete soils have more clay in the B2 horizon, a more distinct B3ca horizon, and a thinner solum.

Profile of Crete silt loam (2,640 feet north and 800 feet west of the southeast corner of sec. 5, T. 2 S., R. 2 W.):

Ap—0 to 7 inches, grayish-brown (10YR 5/2) silt loam, very dark grayish brown (10YR 3/2) when moist; weak, fine, granular structure and massive; slightly hard when dry, friable when moist; slightly acid; abrupt smooth boundary.

A12—7 to 11 inches, dark grayish-brown (10YR 4/2) silt loam, very dark brown (10YR 2/2) when moist; moderate, medium and fine, granular structure; slightly hard when dry, friable when moist; slightly acid; clear, smooth boundary.

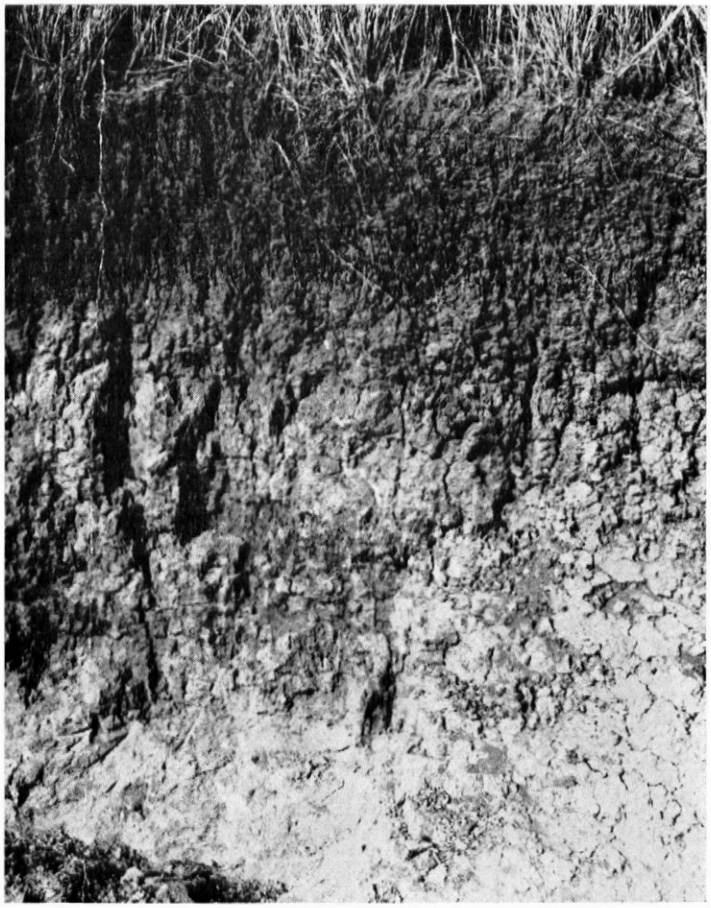


Figure 17.—**Profile of Crete silt loam. Dark-colored, friable A1 and B1 horizons overlie a very firm B2t horizon.**

B1—11 to 15 inches, dark grayish-brown (10YR 4/2) silty clay loam, very dark grayish brown (10YR 3/2) when moist; moderate, fine, subangular blocky structure; dark-colored clay films; hard when dry, firm when moist; slightly acid; gradual, smooth boundary.

B21t—15 to 21 inches, dark grayish-brown (10YR 4/2) silty clay, very dark grayish brown (10YR 3/2) when moist; moderate, medium and fine, angular blocky structure; thick, dark-colored clay films; very hard when dry, very firm when moist; neutral; gradual, smooth boundary.

B22t—21 to 30 inches, grayish-brown (10YR 5/2) silty clay, dark grayish brown (10YR 4/2) when moist; moderate, medium, angular blocky structure; thick clay films; extremely hard when dry, very firm when moist; neutral; gradual, smooth boundary.

B3ca—30 to 36 inches, light brownish-gray (10YR 6/2) silty clay loam, grayish brown (10YR 5/2) when moist; few, faint, fine mottles of dark brown; moderate, medium and fine, subangular blocky structure; moderately thick clay films; hard when dry, firm when moist; many, small, hard concretions of calcium carbonate; alkaline; gradual, smooth boundary.

Cca—36 to 60 inches, light brownish-gray (2.5Y 6/2) silt loam to silty clay loam, grayish brown (2.5Y 5/2) when moist; many, distinct, coarse mottles of dark brown and yellow; weak, medium, subangular blocky structure and massive; slightly hard when dry, friable when moist; small, hard concretions and soft, white coatings of calcium carbonate; scattered, small concretions of iron; calcareous.

The A horizon ranges from 6 to 14 inches in thickness and from dark grayish brown to grayish brown in color. The thickness of the B1 horizon ranges from 2 to 4 inches in nearly level areas to 4 to 6 inches in sloping areas. The B2 horizon ranges from grayish brown to dark brown. In most nearly level areas, the B2 horizon has few, fine, faint mottles of dark brown and yellowish brown. The thickness of the solum ranges from 30 to 42 inches.

Detroit Series

The Detroit soils consist of deep, nearly level, moderately well drained soils that developed in silt and clay alluvium on terraces. These soils occupy slight depressions in the valley of the Republican River. They have slow runoff and internal drainage. Permeability is moderately slow, and some areas are ponded after rains.

The Detroit soils contain more clay throughout the profile and are less well drained than the Muir soils and are calcareous nearer the surface. In contrast to the Eudora soils, the Detroit soils contain more clay throughout the profile, are less well drained, and are darker colored. The Detroit soils, which occur on terraces above the Humbarger soils on the flood plains, are less stratified than the Humbarger soils and are not calcareous in the A horizon and upper B horizon.

Profile of Detroit silty clay loam, in a cultivated field (1,050 feet east and 75 feet south of the northwest corner of sec. 15, T. 4 S., R. 4 W.):

Ap—0 to 6 inches, dark grayish-brown (10YR 4/2) silty clay loam, very dark brown (10YR 2/2) when moist; weak, fine, granular structure and massive; hard when dry, friable when moist; mildly alkaline; abrupt, smooth boundary.

A12—6 to 12 inches, dark-gray (10YR 4/1) silty clay loam, very dark brown (10YR 2/2) when moist; moderate, medium and fine, granular structure; hard when dry, friable when moist; mildly alkaline; gradual, smooth boundary.

B21t—12 to 24 inches, dark-gray (10YR 4/1) heavy silty clay loam, very dark brown (10YR 2/2) when moist; moderate, medium and fine, subangular blocky structure; very hard when dry, firm when moist; mildly alkaline; gradual, smooth boundary.

B22t—24 to 48 inches, gray (10YR 5/1) silty clay, very dark gray (10YR 3/1) when moist; few, faint, fine and medium mottles of dark brown; moderate, medium and fine, angular blocky structure; extremely hard when dry, very firm when moist; mildly alkaline; gradual, smooth boundary.

Cca—48 to 60 inches, light brownish-gray (10YR 6/2) heavy silty clay loam, dark grayish brown (10YR 4/2) when moist; common, faint, medium mottles of strong brown; moderate, medium and fine, angular blocky structure; very hard when dry, firm when moist; calcareous; small, hard concretions of calcium carbonate.

The A horizon ranges from grayish brown to very dark grayish brown in color and from 8 to 14 inches in thickness. In places the B2 horizon is grayish brown and distinctly mottled. The C horizon ranges from friable silty clay loam to stratified silty clay loam and silt loam. In some places the Detroit soils are noncalcareous to a depth of 50 inches. A sandy layer occurs below 48 inches in some areas.

Englund Series

The Englund series is made up of deep, moderately well drained soils that have medium runoff and internal drainage and moderately slow permeability. These soils developed in silty shale of the Dakota formation and they are in small, gently sloping areas on the hillsides in the southeastern part of the county.

The Englund soils have a grayer, more clayey B2 horizon than the Lancaster soils. A Cca horizon occurs in the Englund soils but is lacking in the Lancaster. A distinct B2 horizon distinguishes the Englund soils from the Hedville soils, which have an A–C profile. In contrast to the Crete soils, the Englund soils have an indistinct or no B1 horizon, and they contain more clay in the B3 and C horizons. Englund soils developed in silty shale, but the Crete soils developed in loess.

Profile of Englund silty clay loam in native range (600 feet south and 600 feet east of the northwest corner of sec. 24, T. 4 S., R. 1 W.):

A1—0 to 12 inches, gray (10YR 5/1) silty clay loam, very dark gray (10YR 3/1) when moist; moderate, fine, granular structure; hard when dry, friable when moist; slightly acid; clear, smooth boundary.

B21t—12 to 26 inches, gray (10YR 5/1) silty clay, dark gray (10YR 4/1) when moist; moderate, medium and fine, angular blocky structure; well-developed, dark-colored clay films; very hard when dry, very firm when moist; neutral; gradual, smooth boundary.

B22t—26 to 32 inches, grayish-brown (10YR 5/2) silty clay, dark grayish brown (10YR 4/2) when moist; few, faint, fine mottles of dark brown; moderate, medium and fine, angular blocky structure; thick clay films; very hard when dry, very firm when moist; neutral; gradual, smooth boundary.

B3—32 to 38 inches, gray (10YR 6/1) silty clay loam, grayish brown (10YR 5/2) when moist; common, distinct, medium mottles of dark brown; moderate, medium and fine, subangular blocky structure; moderately thick clay films in upper part; hard when dry, firm when moist; neutral; gradual, smooth boundary.

Cca—38 to 60 inches, light-gray (2.5Y 7/2) silty clay loam, light brownish gray (2.5Y 6/2) when moist; common, distinct, medium to coarse mottles of dark brown and yellowish brown; weak, medium and fine, subangular blocky structure; hard when dry, friable when moist; distinct concretions of calcium carbonate and soft coating.

The A horizon ranges from gray to dark grayish brown in color and from 10 to 14 inches in thickness. A thin B1 horizon occurs in some areas. Depth to the Cca horizon ranges from 38 to 50 inches. In places the Cca horizon contains partly weathered fragments of shale.

Eudora Series

The Eudora series consists of deep, well-drained soils that developed in loamy alluvium on terraces. These soils occur in the valley of the Republican River and are nearly level to gently undulating and sloping. Runoff is slow in the less sloping areas but is medium in sloping areas. Internal drainage is medium, and permeability is moderate.

The Eudora soils have a lighter colored, thinner A horizon and a less clayey profile than the Muir and Detroit soils. The profile of the Eudora soils is more sandy than that of the Kenesaw soils, which developed in silty loess. Eudora soils have a darker, more distinct A1 horizon than the Carr soils and are less stratified and less limy.

Profile of Eudora loam in a cultivated field (500 feet east and 500 feet south of the northwest corner of sec. 33, T. 3 S., R. 4 W.):

Ap—0 to 6 inches, grayish-brown (10YR 5/2) loam, very dark grayish brown (10YR 3/2) when moist; weak, fine,

granular structure and massive; loose when dry, very friable when moist; neutral; abrupt, smooth boundary.

A12—6 to 10 inches, grayish-brown (10YR 5/2) loam, very dark grayish brown (10YR 3/2) when moist; weak, medium and fine, granular structure; slightly hard when dry, very friable when moist; neutral; gradual, smooth boundary.

AC—10 to 18 inches, grayish-brown and light-gray (10YR 5/2 and 7/2) loam, dark grayish brown and grayish brown (10YR 4/2 and 5/2) when moist; weak, medium and fine, granular structure; slightly hard when dry, friable when moist; neutral; gradual, smooth boundary.

C—18 to 40 inches, light-gray (10YR 7/2) very fine sandy loam, grayish brown (10YR 5/2) when moist; very weak, medium, granular structure and massive; slightly hard when dry, friable when moist; neutral; soft, white coatings of calcium carbonate; gradual, smooth boundary.

A1b—40 to 60 inches, dark grayish-brown (10YR 4/2) silt loam, very dark brown (10YR 2/2) when moist; moderate, medium and fine, granular structure; slightly hard when dry, friable when moist; mildly alkaline; soft, white coatings of calcium carbonate.

The A horizon ranges from light brownish gray or brown to dark grayish brown in color and from 6 to 15 inches in thickness. The A and AC horizons combined range from 14 to 24 inches in thickness. In some places, the AC horizon is missing and the A horizon is directly over the C horizon. The C horizon is generally loam or fine sandy loam, but in some places loam and fine sandy loam are stratified. In many areas the C horizon is calcareous in the lower 12 inches. Depth to the buried soil ranges from 36 to 60 inches but generally is about 40 inches. The A1b horizon ranges from silt loam to clay loam or silty clay loam and in almost all places contains concretions of calcium carbonate.

Geary Series

The Geary series is made up of deep, well-drained soils that have medium runoff and internal drainage and moderately slow permeability. These soils are in medium to large sloping and gently rolling areas. They occur throughout the county but are mostly in the northern half.

The Geary soils are redder and have less clay in the B2 horizon than the Crete and Butler soils. They have redder B and C horizons than the Hastings soils. The parent material of the Geary soils is mixed materials deposited mainly by wind, but that of the Tully soils is local colluvium. The B and C horizons of Geary soils are brighter and less alkaline than those of the Tully soils. The Geary soils are deeper than the Lancaster soils and contain more lime.

Profile of Geary silt loam in native grass meadow (1,740 feet west and 75 feet north of the southeast corner of sec. 26, T. 1 S., R. 4 W.):

A1—0 to 12 inches, dark grayish-brown (10YR 4/2) silt loam, very dark grayish brown (10YR 3/2) when moist; moderate, medium and fine, granular structure; hard when dry, friable when moist; neutral; gradual, smooth boundary.

B1—12 to 22 inches, strong-brown (7.5YR 5/6) clay loam, dark brown (7.5YR 4/4) when moist; moderate, medium and fine, subangular blocky structure; moderately thick clay films; hard when dry, firm when moist; neutral; gradual, smooth boundary.

B2t—22 to 36 inches, reddish-yellow (7.5YR 6/6) clay loam, strong brown (7.5YR 5/6) when moist; moderate, medium and fine, subangular blocky structure; moderately thick clay films; very hard when dry, firm when moist; neutral; gradual, smooth boundary.

B3—36 to 48 inches, pink (7.5YR 7/4) light clay loam, brown (7.5YR 5/4) when moist; moderate, medium and fine, subangular blocky structure; thin clay films; hard when dry, firm when moist; neutral; gradual, smooth boundary.

IIC—48 to 60 inches, pink (7.5YR 7/4) sandy clay loam, brown (7.5YR 5/4) when moist; weak, medium, subangular blocky structure; hard when dry, firm when moist; neutral; a few hard concretions of calcium carbonate.

The A horizon ranges from grayish brown to very dark grayish brown in color, from silt loam to silty clay loam or clay loam in texture, and from 10 to 14 inches in thickness. The B horizon ranges from brown to reddish yellow. It is generally clay loam or silty clay loam but in some places ranges from clay loam to sandy clay loam. The thickness of the solum ranges from 40 to 50 inches. The C horizon ranges from yellowish brown to pinkish and from clay loam or loam to silty clay loam. In some areas all the horizons are silty clay loam, and in these areas the profile contains B3ca and Cca horizons. In some places there are few, if any, concretions of calcium carbonate within 60 inches of the surface. Variable amounts of fine, rounded pebbles occur on the surface or throughout the profile. These pebbles are more plentiful in areas that have a clay loam B horizon. In many areas stratified layers of sand and gravel occur below a depth of 6 feet.

Hastings Series

The Hastings series is made up of deep, well-drained soils that developed in Peorian loess. These soils occur in small to large areas throughout the county. They are nearly level to sloping or gently undulating. Figure 18 gives a profile of a Hastings soil.

***Figure 18.*—Profile of Hastings silt loam. Dark-colored, friable A1 and B1 horizons overlie a firm B2t horizon.**

The Hastings soils are browner than the Crete and Butler soils and have less clay in the B2 horizon. Unlike the Geary soils, which have a brown to reddish-brown B2 horizon and a pinkish C horizon, the Hastings soils have a grayish-brown to brown B2 horizon and a grayish-brown C horizon. Hastings soils have a distinct B horizon, but this horizon is missing in the Kenesaw soils.

Profile of Hastings silt loam (2,140 feet west and 100 feet north of the southeast corner of sec. 18, T. 1 S., R. 4 W.):

Ap—0 to 6 inches, grayish-brown (10YR 5/2) silt loam, very dark grayish brown (10YR 3/2) when moist; weak, fine, granular structure and massive; slightly hard when dry, friable when moist; slightly acid; abrupt, smooth boundary.

A12—6 to 14 inches, dark grayish-brown (10YR 4/2) silt loam, very dark brown (10YR 2/2) when moist; moderate, medium and fine, granular structure; slightly hard when dry, friable when moist; slightly acid; gradual, smooth boundary.

B1—14 to 20 inches, dark grayish-brown (10YR 4/2) silty clay loam, very dark grayish brown (10YR 3/2) when moist; moderate, fine, subangular blocky structure; dark-colored clay films; hard when dry, friable when moist; slightly acid; gradual, smooth boundary.

B21t—20 to 26 inches, brown (10YR 5/3) silty clay loam, dark brown (10YR 3/3) when moist; moderate, medium and fine, subangular blocky structure; thick, dark-colored clay films; hard when dry, firm when moist; neutral; gradual, smooth boundary.

B22t—26 to 34 inches, grayish-brown (10YR 5/2) silty clay loam, dark grayish brown (10YR 4/2) when moist; moderate, medium, angular blocky structure; thick clay films; very hard when dry, very firm when moist; neutral; gradual, smooth boundary.

B3ca—34 to 46 inches, light brownish-gray (10YR 6/2) silty clay loam, grayish brown (10YR 5/2) when moist; moderate, medium and fine, subangular blocky structure; moderately thick clay films; hard when dry, firm when moist; noncalcareous; numerous, small concretions of calcium carbonate; gradual, smooth boundary.

Cca—46 to 60 inches, pale-brown (10YR 6/3) light silty clay loam, grayish brown (10YR 5/2) when moist; few, distinct, fine mottles of strong brown; weak, medium, subangular blocky structure and massive; slightly hard when dry, friable when moist; small, hard concretions and soft, white coatings of calcium carbonate; calcareous below 50 inches.

The A horizon ranges from grayish brown to dark grayish brown or dark gray in color and from 8 to 15 inches in thickness. The A horizon is generally silt loam, but it is silty clay loam in some places. The B2 horizon ranges from grayish brown to brown. The B2 horizon is generally silty clay loam, but in some areas it has a thin layer of silty clay. The solum ranges from 36 to 50 inches in thickness. Depth to calcareous material generally ranges from 48 to 60 inches but in places is as little as 40 inches. The mottling in the C horizon ranges from faint to distinct.

Hedville Series

The Hedville series consists of shallow, excessively drained soils that occur in gently rolling and rolling areas in the southeastern part of the county. These soils developed in sandstone and sandy shale of the Dakota formation. They have moderate to rapid runoff, moderate internal drainage, and moderate to moderately rapid permeability.

The Hedville soils occur with the Englund and Lancaster soils, but they lack the B horizon that occurs in those soils. The Hedville soils are noncalcareous, whereas the Kipson soils are calcareous.

Profile of Hedville loam in native range (1,400 feet west and 150 feet north of the southeast corner of sec. 36, T. 4 S., R. 3 W.):

A1—0 to 10 inches, grayish-brown (10YR 5/2) loam, very dark grayish brown (10YR 3/2) when moist; moderate, medium and fine, granular structure; slightly hard when dry, friable when moist; medium acid; gradual, smooth boundary.

C—10 to 14 inches, dark grayish-brown (10YR 4/2) loam, dark brown (10YR 3/3) when moist; weak, medium and fine, granular structure; slightly hard when dry, friable when moist; slightly acid.

R—14 inches +, slightly weathered brown sandstone.

The A horizon ranges from grayish brown to very dark grayish brown or dark brown in color, from loam to stony loam in texture, and from 5 to 12 inches in thickness. The C horizon ranges from grayish brown to reddish brown or dark red in color, from loam to sandy loam in texture, and from 3 to 12 inches in thickness. Depth to bedrock generally ranges from 10 to 24 inches, but in only a few places is the soil more than 10 inches thick. The bedrock is generally brown sandstone, but in places it is sandstone interbedded with reddish sandy shale. Loose stones are commonly on the surface and in the soil.

Hobbs Series

The Hobbs series is made up of moderately well drained, nearly level to gently sloping soils that are weakly stratified. These soils developed in silt and clay deposits on the flood plains of small streams throughout the county. Most areas are cut by meandering streams and are irregular. Runoff is slow, internal drainage is medium, and permeability is moderately slow. Reaction is slightly acid or neutral.

The Hobbs soils have a darker colored A horizon than the Humbarger soils and are less stratified and less limy. They are darker colored, less stratified and less sandy than the Carr and Sarpy soils. The Hobbs soils are more frequently flooded and more stratified than the Muir soils.

Profile of Hobbs silt loam in a cultivated field (300 feet west and 50 feet north of the southeast corner of sec. 9, T. 2 S., R. 1 W.):

Ap—0 to 7 inches, grayish-brown (10YR 5/2) silt loam, very dark grayish brown (10YR 3/2) when moist; weak, fine, granular structure and massive; hard when dry, friable when moist; neutral; abrupt, smooth boundary.

A12—7 to 48 inches, gray (10YR 5/1) silty clay loam, very dark gray (10YR 3/1) when moist; stratified with thin layers of loam and silt loam; weak, medium and fine, granular structure; hard when dry, friable when moist; neutral; gradual, smooth boundary.

C—48 to 60 inches, dark grayish-brown (10YR 4/2) light silty clay loam, dark brown (10YR 3/3) when moist; moderate, medium and fine, subangular blocky structure; hard when dry, firm when moist; neutral.

The A horizon generally ranges from gray to dark grayish brown, but in some places there are recent deposits of light brownish-gray or grayish-brown material.

In many areas of recent deposition, the surface layer is calcareous. The A horizon generally ranges from silt loam to silty clay loam, but in places thin strata of grayish-brown loam, silt loam, and silty clay loam extend from the surface to a depth of 36 to 48 inches. Limestone gravel occurs in places. The C horizon is distinctly mottled with dark brown in some places.

Humbarger Series

The Humbarger series consists of well drained to moderately well drained soils that developed in silt loam and clay loam deposits on the flood plains of the Republican River. The Humbarger soils are calcareous throughout and are moderately stratified. They are nearly level, slightly concave, and gently undulating. These soils have a water table that fluctuates between 3 and 12 feet but is below 4 feet during the growing season. Runoff is slow, internal drainage is medium, and permeability is moderately slow.

The Humbarger soils have a darker colored A horizon and a finer textured profile than the Carr and Sarpy soils. Unlike the Hobbs soils, which are noncalcareous to a depth of 36 inches or more, the Humbarger soils are calcareous throughout. The Humbarger soils are more stratified, more frequently flooded, and more limy than the Detroit and Muir soils.

Profile of a Humbarger loam in a cultivated field (1,850 feet south and 100 feet west of the northeast corner of sec. 30, T. 3 S., R. 4 W.):

Ap—0 to 7 inches, grayish-brown (10YR 5/2) loam, very dark grayish brown (10YR 3/2) moist; weak, fine, granular structure and massive; slightly hard when dry, friable when moist; calcareous; abrupt, smooth boundary.

AC—7 to 30 inches, gray (10YR 5/1) silt loam, very dark gray (10YR 3/1) when moist; thinly stratified with loam and fine sandy loam; moderate, medium and fine, granular structure; hard when dry, firm when moist; calcareous; gradual, smooth boundary.

C1—30 to 48 inches, light brownish-gray (10YR 6/2) silt loam, grayish brown (10YR 5/2) when moist; stratified with loam, fine sandy loam, and loamy fine sand; very weak, medium and fine, granular structure and single grain; slightly hard when dry, friable when moist; calcareous; clear, smooth boundary.

IIC2—48 to 60 inches, light-gray (10YR 7/2) loamy fine sand, light brownish gray (10YR 6/2) when moist; loose; single grain; calcareous.

The A horizon ranges from grayish brown or gray to dark grayish brown. Texture is generally loam or silt loam, but small areas of fine sandy loam occur. The AC horizon ranges from gray to dark gray or from grayish brown to dark grayish brown. This layer is stratified mainly with silt loam or loam and contains lesser amounts of fine sandy loam, clay loam, or silty clay loam. The AC horizon ranges from 7 to 30 inches in thickness. The C horizon ranges from light brownish gray or gray to grayish brown and, in places, is faintly to distinctly mottled with dark brown. The thickness of the C horizon ranges from less than 6 to more than 30 inches. A layer of loose white sand or dark-gray silty clay may occur at almost any depth below the surface layer. The thickness of the medium to moderately fine textured soil over the IIC horizon of sand or sand and gravel ranges from 30 to more than 60 inches.

Kenesaw Series

In the Kenesaw series are deep, well-drained soils that developed in Peorian loess. These undulating to gently rolling soils occur in small areas on the bluffs along the valley of the Republican River. Runoff is medium to rapid, internal drainage is medium, and permeability is moderate.

The Kenesaw soils lack the B horizon of clay enrichment that occurs in the Butler, Crete, Hastings, and Geary soils. Kenesaw soils are less sandy and are more limy than the Eudora and Ortello soils.

Profile of Kenesaw silt loam in a cultivated field (1,500 feet north and 50 feet west of the southeast corner of sec. 18, T. 2 S., R. 4 W.):

Ap—0 to 6 inches, grayish-brown (10YR 5/2) silt loam, very dark grayish brown (10YR 3/2) when moist; weak, fine, granular structure; loose when dry, very friable when moist; neutral; abrupt, smooth boundary.

A12—6 to 13 inches, dark grayish-brown (10YR 4/2) silt loam, very dark grayish brown (10YR 3/2) when moist; moderate, medium and fine, granular structure; slightly hard when dry, very friable when moist; neutral; gradual, smooth boundary.

AC—13 to 22 inches, mixed colors same as in A1 and C1 horizons, silt loam; weak, medium and fine, granular structure; slightly hard when dry, friable when moist; neutral; gradual, smooth boundary.

C1—22 to 30 inches, pale-brown (10YR 6/3) silt loam, brown (10YR 5/3) when moist; weak, fine, granular structure; slightly hard when dry, friable when moist; neutral; gradual, smooth boundary.

C2ca—30 to 60 inches, pale-brown (10YR 6/3) silt loam, brown (10YR 5/3) when moist; massive; slightly hard when dry, friable when moist; calcareous; small, hard concretions and soft, white coatings of cacium carbonate.

The A horizon ranges from gray or grayish brown to dark grayish brown in color and from 6 to 14 inches in thickness. The A and AC horizons combined range from 12 to 24 inches in thickness. In places the C horizon is spotted with yellowish brown and strong brown. Depth to the C2ca horizon generally ranges from 24 to 36 inches, but in some eroded areas, calcareous material is less than 12 inches from the plow layer.

Kipson Series

The Kipson series is made up of shallow, well-drained to excessively drained soils that have medium to rapid surface drainage, medium internal drainage, and moderate to moderately rapid permeability. These soils developed in material weathered from limestone and shale from the Greenhorn formation. They occur in areas of various size throughout the county. The areas are large in the southern half of the county, east of the Republican River. These soils are on gently sloping hilltops and moderately steep side slopes. Figure 19 shows a profile of a Kipson soil.

The Kipson soils have a calcareous A horizon over limestone and shale, whereas the Hedville soils have a noncalcareous A horizon over sandstone and shale.

Profile of Kipson loam in native range (1,050 feet south and 75 feet west of the northeast corner of sec. 5, T. 4 S., R. 3 W.):

A1—0 to 10 inches, dark-gray (10YR 4/1) loam, very dark brown (10YR 2/2) when moist; moderate, fine, granular structure; slightly hard when dry, friable

Figure 19.—**Profile of Kipson loam. A dark-colored A1 horizon overlies a thin, light-colored C horizon. This soil developed from thin-bedded, fractured limestone and calcareous shale.**

when moist; calcareous; numerous small fragments of limestone; gradual, smooth boundary.

C—10 to 20 inches, white (10YR 8/1) shaly loam, pale brown (10YR 6/3) when moist; mass of soil and weathered fragments of limestone and calcareous shale.

R—20 inches +, interbedded limestone and calcareous shale.

The A horizon ranges from dark gray to dark grayish brown or grayish brown in color and from 6 to 15 inches in thickness. It is loam to silt loam that contains numerous fragments of shale and limestone. The C horizon ranges from shaly loam to shaly silt loam or silty clay loam in texture and from less than 1 inch to 10 or 15 inches in thickness. In some areas the C horizon is yellowish-brown shaly silty clay loam that grades to partly weathered shale. In other areas the dark-gray A horizon is directly over partly weathered limestone. On slopes steeper than 15 percent, the soil is only 3 to 6 inches thick over slightly weathered shale and limestone. Loose stones are common on the surface and in the soil, and bedrock crops out in many places.

Lancaster Series

The Lancaster series is made up of moderately deep to deep, well-drained soils that developed in material weathered from sandstone and sandy shale of the Dakota formation. These soils occur on gently sloping ridgetops and side slopes in the southeastern part of the county. They have medium runoff and internal drainage and moderately slow permeability.

The Lancaster soils are redder and have less clay in the B and C horizons than the Englund soils. Unlike the Hedville soils, Lancaster soils have a developed B horizon. They are redder, have less clay in the B horizon, and are not so deep as the Crete soils. Lancaster soils have reddish B and C horizons that developed in weathered sandstone and shale, whereas the Hastings soils have brownish B and grayish-brown C horizons that developed in loess. The Lancaster soils are more acid than the Geary and Tully soils but are not so deep. Also, they occur on ridgetops and side slopes, whereas the Tully soils occur on gently sloping deposits of colluvium.

Profile of a Lancaster loam in native range (300 feet north and 600 feet west of the southeast corner of sec. 24, T. 4 S., R. 1 W.):

A1—0 to 10 inches, gray (10YR 5/1) loam, very dark grayish brown (10YR 3/2) when moist; moderate, medium and fine, granular structure; hard when dry, friable when moist; slightly acid; gradual, smooth boundary.

B1—10 to 15 inches, brown (7.5YR 5/4) clay loam, dark brown (7.5YR 4/4) when moist; moderate, medium and fine, subangular blocky structure; moderately thick clay films; hard when dry, firm when moist; slightly acid; gradual, smooth boundary.

B2t—15 to 34 inches, yellowish-red (5YR 5/6) clay loam, yellowish red (5YR 4/6) when moist; moderate, medium and fine, subangular blocky structure; thick clay films; very hard when dry, firm when moist; neutral; gradual, smooth boundary.

B3—34 to 42 inches, reddish-yellow (5YR 6/6) clay loam, yellowish red (5YR 5/6) when moist; weak, medium and fine, subangular blocky structure; thin clay films; hard when dry, friable when moist; neutral; gradual, smooth boundary.

C—42 to 50 inches, reddish-yellow (7.5YR 6/8) loam, strong brown (7.5YR 5/8) when moist; weak, medium and fine, granular structure; hard when dry, friable when moist; neutral; clear, smooth boundary.

R—50 inches +, weathered, brown Dakota sandstone.

The A horizon ranges from gray to dark grayish brown or dark brown in color and from 8 to 12 inches in thickness. The B2t horizon ranges from strong brown to yellowish red and from 30 to 40 inches in thickness. The C horizon ranges from brown to reddish yellow in color and from loam to sandy loam in texture. Depth to partly weathered sandstone ranges from 40 to 60 inches. In some areas sandstone fragments of various size occur in places throughout the profile. In areas where loess was deposited, the A horizon is grayish silt loam and the upper part of the B horizon is grayish-brown silty clay loam that grades to a lower subsoil of reddish clay loam.

Where erosion has removed most of the A horizon, the surface layer ranges from dark brown to reddish brown and from loam to clay loam. In these eroded areas, the thickness of the solum ranges from 36 to 40 inches.

Muir Series

The Muir series consists of deep, well-drained, nearly level to gently sloping soils that developed in silt and clay alluvium on terraces. These soils generally have slow runoff and medium internal drainage, but in sloping areas, surface drainage is medium. Permeability is moderately slow to moderate. Muir soils occur in the valley of the Republican River and in most other valleys in the county. Figure 20 shows a profile of a Muir soil.

The Muir soils are more clayey than the Eudora soils and have a darker colored, thicker A horizon. They have less clay in the B and C horizons than the Detroit soils. The Muir soils have a darker colored, thicker A horizon than the Kenesaw soils and contain more clay in the B horizon. The Muir soils have a thicker A horizon than the Hobbs and Humbarger soils and are less stratified

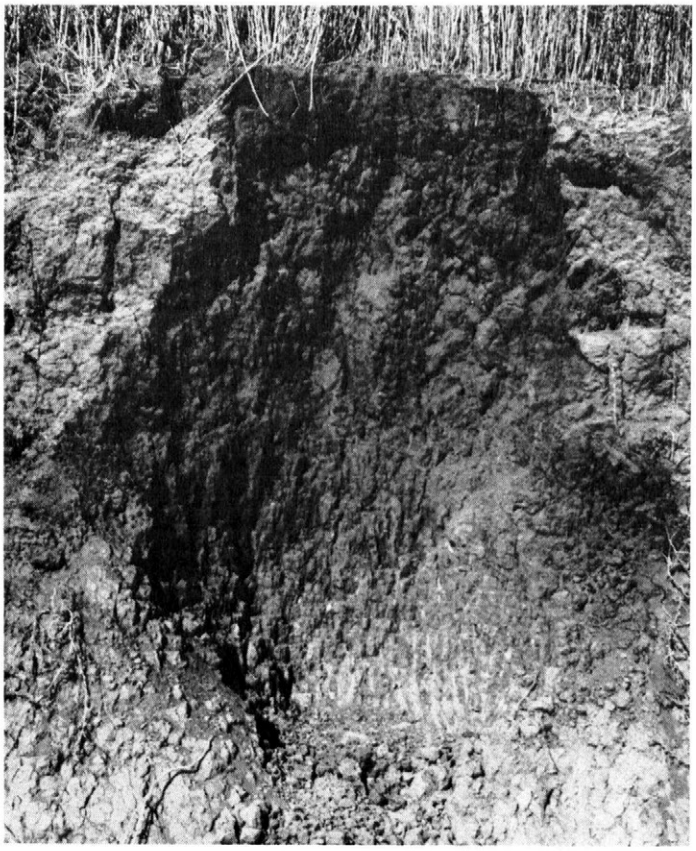


Figure 20.—**Profile of Muir silt loam. The dark-colored, thick A1 horizon overlies a friable B2 horizon.**

and less frequently flooded. Also, the Muir soils have a B horizon, and the Hobbs and Humbarger soils do not.

Profile of Muir silt loam in a cultivated field (1,320 feet south and 100 feet west of the northeast corner of sec. 9, T. 4 S., R. 4 W.) :

Ap—0 to 7 inches, grayish-brown (10YR 5/2) silt loam, very dark grayish brown (10YR 3/2) when moist; weak, fine, granular structure and massive; slightly hard when dry, very friable when moist; neutral; abrupt, smooth boundary.

A12—7 to 26 inches, dark-gray (10YR 4/1) silt loam, very dark brown (10YR 2/2) when moist; moderate, fine, granular structure; slightly hard when dry, friable when moist; neutral; gradual, smooth boundary.

B2—26 to 44 inches, grayish-brown (10YR 5/2) silt loam, very dark grayish brown (10YR 3/2) when moist; weak, medium and fine, granular structure; slightly hard when dry, friable when moist; neutral; gradual, smooth boundary.

C1—44 to 60 inches, light brownish-gray (10YR 6/2) loam, grayish brown (10YR 5/2) when moist; weak, medium, subangular blocky structure and massive; slightly hard when dry, very friable when moist; mildly alkaline.

The A horizon ranges from gray to dark grayish brown or grayish brown in color, from silt loam to loam in texture, and generally from 15 to 30 inches in thickness. The B horizon ranges from grayish brown to brown and from 12 to 24 inches in thickness, but in most places, it is 10 to 16 inches thick. The B horizon ranges from silt loam to silty clay loam but is silt loam in most places. The thickness of the solum ranges from 30 to 50 inches but is 30 to 40 inches in sloping areas. The C horizon ranges from light brownish gray to grayish brown and from silt loam to fine sandy loam. In places soft, white coatings of calcium carbonate occur in the C horizon below 50 inches.

Near the valley walls, or where the smaller streams enter the larger streams, limestone gravel occurs on the surface or as lenses below the surface. In sloping areas, the surface layer ranges from gray to dark grayish brown and from 6 to 16 inches in thickness. Near the base of some slopes, a dark-colored layer of silt loam or grayish-brown fine sandy loam crops out.

Ortello Series

The Ortello series is made up of deep, well-drained soils that have medium runoff and internal drainage and moderately slow to moderate permeability. These soils developed in wind-deposited sandy loam material. They occur on the Otter (Sandy) Creek watershed, northeast of the town of Republic, and are gently undulating and sloping.

The Ortello soils are less limy than the Hastings soils but are more sandy in the B and C horizons. They are more sandy and less limy than the Kenesaw soils. Ortello soils have brighter colored B and C horizons and are more sandy than the Eudora soils.

Profile of Ortello fine sandy loam (1,240 feet east and 1,450 feet south of the northwest corner of sec. 22, T. 1 S., R. 4 W.) :

Ap—0 to 6 inches, grayish-brown (10YR 5/2) fine sandy loam, very dark grayish brown (10YR 3/2) when moist; medium granular structure; soft when dry; very friable when moist; medium acid; abrupt, smooth boundary.

A12—6 to 10 inches, grayish-brown (10YR 5/2) fine sandy loam, very dark grayish brown (10YR 3/2) when moist; weak, medium and fine, granular structure; slightly hard when dry, very friable when moist; medium acid; gradual, smooth boundary.

AB—10 to 22 inches, light yellowish-brown (10YR 6/4) fine sandy loam, dark yellowish brown (10YR 4/4) when moist; weak, medium and fine, granular structure; slightly hard when dry, friable when moist; slightly acid; gradual, smooth boundary.

B2—22 to 36 inches, light yellowish-brown (10YR 6/4) loam, yellowish brown (10YR 5/4) when moist; weak, medium and fine, granular structure; hard when dry, friable when moist; neutral; gradual, smooth boundary.

C—36 to 60 inches, brownish-yellow (10YR 6/6) fine sandy loam, yellowish brown (10YR 5/6) when moist; massive; sightly hard when dry, very friable when moist; neutral.

The A horizon ranges from gray to dark grayish brown in color and from 6 to 16 inches in thickness. It generally ranges from fine sandy loam to loam but is loamy fine sand in some areas. The B horizon ranges from yellowish brown to brown and from loam to fine sandy loam. The solum is 30 to 48 inches thick. In most places concretions of coatings of calcium carbonate do not occur within 50 inches of the surface.

Sarpy Series

The Sarpy series consists of well-drained to somewhat excessively drained, gently undulating soils that devel-

oped in loamy sand deposited on the flood plains of the Republican River. These soils are moderately stratified, are neutral in the upper subsoil, and are calcareous below a depth of 20 inches. They have slow runoff, rapid internal drainage, and moderate to moderately rapid permeability.

The Sarpy soils are sandier than the Carr soils, and their A horizon is noncalcareous instead of calcareous. The Sarpy soils are more sandy throughout than the Humbarger soils and Hobbs soils and are less limy in the surface layer than the Humbarger soils.

Profile of a Sarpy loamy fine sand (1,500 feet west and 250 feet south of the northeast corner of sec. 7, T. 1 S., R. 5 W.):

A1—0 to 7 inches, grayish-brown (10YR 5/2) loamy fine sand, very dark grayish brown (10YR 3/2) when moist; single grain; loose when dry or moist; neutral; abrupt, smooth boundary.

AC—7 to 20 inches, light brownish-gray (10YR 6/2) loamy fine sand, dark grayish brown (10YR 4/2) when moist; weak, medium, granular structure; soft when dry, very friable when moist; neutral; gradual, smooth boundary.

C—20 to 60 inches, light-gray (10YR 7/1) loamy sand; light brownish gray (10YR 6/2) when moist; single grain; loose when dry or moist; moderately calcareous.

The A horizon ranges from gray or light brownish gray to dark grayish brown in color, from loamy fine sand to loamy sand in texture, and from 8 to 14 inches in thickness. The AC horizon is stratified in places but generally is loamy fine sand. A thin layer of loose white sand, of gray silty material, or of dark-gray clayey material may occur at almost any depth. Depth to calcareous material ranges from 15 to 24 inches. The C horizon grades to the loose sand or to sand and gravel. Below a depth of 36 inches in some places are coarse, dark-brown spots or streaks.

Tully Series

The Tully series is made up of deep, well-drained soils that have medium runoff and internal drainage and moderately slow permeability. These soils developed in colluvium from limestone and shale hills capped with loess. They occur on gently sloping foot slopes in the southern half of the county.

The Tully soils are redder and have less clay in the B2 horizon than the Crete soils. They have redder B and C horizons than the Hastings soils. The Tully soils developed in local colluvium, whereas the Geary soils developed in mixed silty material. The Tully soils have more clayey and less acid B and C horizons than the Geary soils, and they are deeper and more limy than the Lancaster soils.

Profile of a Tully silty clay loam (250 feet west and 100 feet south of the northeast corner of sec. 30, T. 3 S., R. 2 W.):

A1—0 to 12 inches, very dark grayish-brown (10YR 3/2) light silty clay loam, very dark brown (10YR 2/2) when moist; moderate, medium and fine, granular structure; hard when dry, friable when moist; neutral; gradual, smooth boundary.

B1—12 to 20 inches, dark-gray (10YR 4/1) silty clay loam, very dark brown (10YR 2/2) when moist; moderate, medium and fine, subangular blocky structure; moderately developed, dark-colored clay films; hard when dry, firm when moist; neutral; gradual, smooth boundary.

B21t—20 to 30 inches, brown (7.5YR 5/2) heavy silty clay loam, dark brown (7.5YR 3/2) when moist; moderate, fine, angular blocky structure; moderately thin clay films; very hard when dry, firm when moist; neutral; gradual, smooth boundary.

B22t—30 to 44 inches, brown (7.5YR 5/4) silty clay loam, dark brown (7.5YR 4/4) when moist; moderate, medium and fine, angular blocky structure; moderately thin clay films; hard when dry, firm when moist; neutral; gradual, smooth boundary.

B3ca—44 to 52 inches, brown (7.5YR 5/4) silty clay loam, dark brown (7.5YR 4/4) when moist; weak, medium, subangular blocky structure; hard when dry, firm when moist; mildly alkaline; small, hard concretions of calcium carbonate, gradual, smooth boundary.

Cca—52 to 60 inches, reddish-yellow (7.5YR 6/6) silty clay loam, strong brown (7.5YR 5/6) when moist; weak, medium, subangular blocky structure; hard when dry, firm when moist; mildly alkaline; small, hard concretions of calcium carbonate.

The A horizon ranges from dark gray to very dark grayish brown in color, from silty clay loam to silt loam in texture, and from 6 to 14 inches in thickness. The B2 horizon ranges from brown to reddish brown. The solum is 40 to 50 inches thick.

Near the limestone hills, Tully soils have a dark-colored A horizon over brownish B and C horizons in which limestone fragments are scattered. In these areas, Tully soils are calcareous below a depth of 36 inches. Away from the hills, the dark-colored A horizon is underlain by reddish B and C horizons that are mildly alkaline below 40 inches. In places pockets or lenses of limestone gravel occur below a depth of 5 feet. Where erosion has removed a part of the A horizon, the color of the surface layer ranges from grayish brown to brown.

Additional Facts About the County

This section should be useful to those who are not familiar with the county. Discussed are history, climate, agriculture, transportation, and markets.

History

Before the white settlers entered what is now Republic County, it was in the area called the Pawnee Republic and was controlled by a band of Pawnee Indians, whose headquarters were at the site of Pawnee Park, southwest of Republic. The Republican River, which flows southeastward through this area, and Republic County were named after the old Pawnee Republic.

The first white settlers in Republic County came in on the overland trail that led westward into Nebraska and joined the Oregon Trail. This overland trail was used during the Gold Rush.

The Kansas Legislature named Republic County and defined its boundaries in 1860. It was organized as a county in 1868, and Pleasant Hill, in Jefferson Township, was designated as the county seat. By a county-wide vote, the county seat was changed to Belleville in 1870, and it has remained there ever since.

By 1867 all parts of the county were settled. The population increased steadily and in 1880 was more than 14,000. By 1900, there were 18,376 people in the county,

but since then population has decreased. In 1960 the population was 10,083.

Since 1900, about 95 percent of the land in the county has been in farms. In 1955 there were 1,661 farms in the county, and the average-sized farm was 266 acres. By 1960 the number of farms had decreased to 1,483, and the average-sized farm was 298 acres.

Climate [5]

Republic County, which is far from large bodies of water, has a distinctly continental climate that is characterized by warm summers and cold winters. Because there are no effective barriers north or south of the county, the wind sweeps from those directions and causes wide seasonal changes of temperature that are sometimes sudden. The county is in the moister part of the subhumid region and is an area that is transitional from hard winter wheat to feed grains and livestock. Because the county receives more precipitation than areas farther west, more trees grow and grasses are taller. The weather varies, but the sunshine, precipitation, wind, snow, evaporation, and storms occur in such proportions that living conditions are generally comfortable, though they can be severe. Most years are favorable for farming, but there are long periods of drought or of excessively wet weather.

The crop year begins at a time when days are lengthening, winds are gusty, and clouds and showers are considerable, but sunshine is increasing and days are gradually getting warmer. In summer rains are heavier but less frequent than in other seasons, and there is an abundance of sunshine, more humidity, and lighter winds. Storms are more severe and more damaging in spring and summer than in other seasons. Fall, the harvest season, often has a period of Indian summer, but the shorter days and noticeably cooler nights forewarn of the colder season ahead. Generally, winters are not severe enough to stop traffic for much of the time, but occasionally, roads are blocked by snowdrifts, and in spring melting snow makes side roads impassable.

PRECIPITATION: Precipitation and temperature have been recorded daily at Belleville in Republic County since September 1902. Over the years of record, annual rainfall has averaged 27.84 inches. This amounts to 435 million gallons per square mile, or 33.7 million gallons per person. Precipitation varies through the year and from year to year. In at least 1 year there was no measurable rainfall in 7 months, and there have been 4 months in a year when each month had 10 inches or more. Rainfall in September has ranged from 0.01 inch in 1956 to 11.68 inches in 1958. The driest year of record (1934) received only 11.79 inches, and the wettest year (1915) received 45.20 inches.

Because planning construction of soil and water conservation projects, especially of roads and drains, is affected by the frequency of various precipitation intensities, such frequencies are given in table 8. About once each year, 1.0 inch or more of rain may be expected in 30 minutes, and about once in 100 years, there is dashing rainfall of 2.9 inches (*12*). In a 24-hour period, 2.4 inches or more may fall once a year; 6.0 inches or more, about once in 50 years; and 6.9 inches, once in 100 years. The heaviest rains usually occur in the warm season, probably in September.

TABLE 8.—*Frequency of rains of stated duration and intensity at Belleville, Kans.*

Frequency [1]	Duration of—						
	½ hour	1 hour	2 hours	3 hours	6 hours	12 hours	24 hours
Once in—	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*
1 year	1.0	1.3	1.5	1.6	1.9	2.0	2.4
2 years	1.3	1.7	1.9	2.0	2.4	2.5	3.0
5 years	1.7	2.2	2.5	2.6	3.0	3.5	3.9
10 years	2.0	2.5	2.9	3.0	3.5	4.0	4.7
25 years	2.3	3.0	3.4	3.5	4.0	4.8	5.1
50 years	2.6	3.3	3.8	4.0	4.8	5.2	6.0
100 years	2.9	3.7	4.3	4.5	5.1	6.0	6.9

[1] Expresses the frequency of the specified number of inches of rainfall at given time intervals. For example, 1.0 inch of rain can be expected to fall in one-half hour once in each year (100 percent probability), but 2.9 inches can be expected to fall in one-half hour only once in 100 years (1 percent probability).

All of the precipitation in a year is not used by crops because much of the water from heavy rains runs off, and much more is lost through evaporation. Since irrigation water from wells or reservoirs is not generally available throughout the county, the method of tillage and kinds of crops selected should be those that conserve the moisture available.

Figure 21 shows, in percent, probability of receiving specified amounts of precipitation each week of the year.

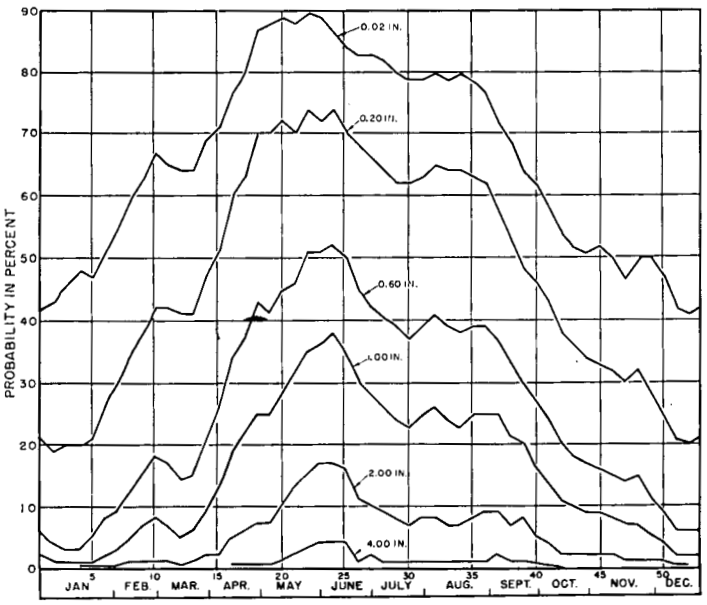


***Figure 21.*—Probability, in percent, of receiving specified amounts of precipitation in each week of the year. Calculated from precipitation data in records at Burr Oak (Jewell Co., Kans.) for period 1903–57.**

[5] By A. D. ROBB, State climatologist, U.S. Weather Bureau, Topeka, Kans.

The 52 weeks of the year are numbered at the bottom of the figure. Figure 21 indicates a marked increase through April and part of May and a decline through September and October. Also shown is a sharp decrease in the probability of rain from the second week of June until about the last of July (*3*). Thus, rain is much more likely early in June and early in August than it is late in July. The chance of any precipitation at all in mid-January is less than half that of late in May. The chance of receiving 1 inch in any week in midwinter is almost negligible.

In seven out of nine summers, there was at least one period of 30 or more consecutive days during the growing season when not more than 0.25 inch of rain fell in 1 day. Such dry periods may continue for more than 30 days. For example, in 1919 there were 81 consecutive days without as much as 0.25 inch of rain on any day (*5*).

Figure 22 compares the annual precipitation with precipitation of the growing season. Fortunately, about three-fourths of the yearly precipitation falls during the growing season. Figure 22 shows that the longest period of deficient rainfall was from 1916 through 1937. The average rainfall for half of the summers in this 22-year period was less than 16 inches.

The probability of receiving specified amounts of rainfall during the summer (April–September) is shown in figure 23. In about 25 percent of the summers, a total of 23.5 inches or more can be expected. In about an equal number of summers, almost 14.0 inches is expected, and the total rainfall in half the summers ranges from 14.0 to 23.5 inches. The value of the rain to farming depends not only on the summer total but also on the frequency of the rain, the timeliness of significant amounts, the soil moisture, and the rate of evaporation.

The average snowfall of 48 seasons was 23 inches, but snowfall varies a great deal from year to year. The greatest amount (66 inches) fell in the winter of 1911–12. Only 1 inch of snow fell in the winter of 1903–04. In the 48 seasons, 8 had less than 10 inches of snow, and about 1 in 10 had 40 inches or more.

Much of the time the snow drifts because of the accompanying high winds, but occasionally the snow is evenly distributed and provides good cover for the wheat and field moisture when it melts. At least twice, measurable snow has covered the ground for long periods. The first was for 56 days, from December 31, 1931, through February 24, 1932, and the other was for 69 days from December 23, 1939, through February 29, 1940.

TEMPERATURES: Comfortable temperatures generally occur in Republic County, though extremes of 100° F. occur in the summer and below zero readings occur in winter. The rather low humidity and fair breeze in summer help cool the body and add to comfort. Similarly, the cold in winter, as well as the chilling effect caused by the wind, is lessened by the dry air.

The probabilities of the last freezing temperatures in spring and the first in fall are given in table 9. Damaging freezes are not a great hazard in this county, because crops are grown that are adapted to the climate. Occasionally, when a slow-warming spring is followed by freezing temperature early in fall, immature crops are damaged because they have not become strong enough to resist the low temperature. Also, in spring the low temperature that follows a period of high temperature may damage crops.

WINDS AND STORMS: The annual average speed of the wind at the Concordia Weather Bureau, in Cloud County south of Republic, is about 8 miles per hour, but the speed ranges from 10 miles per hour in April to 7 miles per hour in July and August. Southerly winds prevail in the warm season, but northerly winds prevail during the colder part of the year, especially in January and February.

The sudden gusts during thunderstorms and other high winds are sometimes destructive. Occasionally, sustained high winds cause soil erosion and snow drifting unless preventive practices are used. On the average, nearly 45 thunderstorms occur each year. Hail is greatly feared in Republic County because it occurs most frequently during thunderstorms in June, about the time grain is harvested. The hail may be driven by strong winds. The hailstones range from those the size of peas or marbles that damage the grain to those the size of walnuts or baseballs that damage livestock and buildings. About one tornado occurs yearly somewhere in the county. A tornado in June 1955 and another in May 1957 were disastrous.

Severe winter storms with high winds, fine snow, and intense cold are characteristic of weather in this area.

TABLE 9.—*Probabilities of last freezing temperatures in spring and first in fall at Belleville* [1]

Probability	Dates for given probability and temperature				
	16° F., or lower	20° F., or lower	24° F., or lower	28° F., or lower	32° F., or lower
Spring:					
1 year in 10, later than	April 3	April 11	April 14	May 1	May 9
2 years in 10, later than	March 28	April 5	April 9	April 26	May 4
5 years in 10, later than	March 16	March 26	March 31	April 16	April 24
Fall:					
1 year in 10, earlier than	November 5	October 25	October 18	October 8	September 28
2 years in 10, earlier than	November 9	October 30	October 22	October 13	October 2
5 years in 10, earlier than	November 22	November 10	November 1	October 22	October 12

[1] From record of period 1903–58.

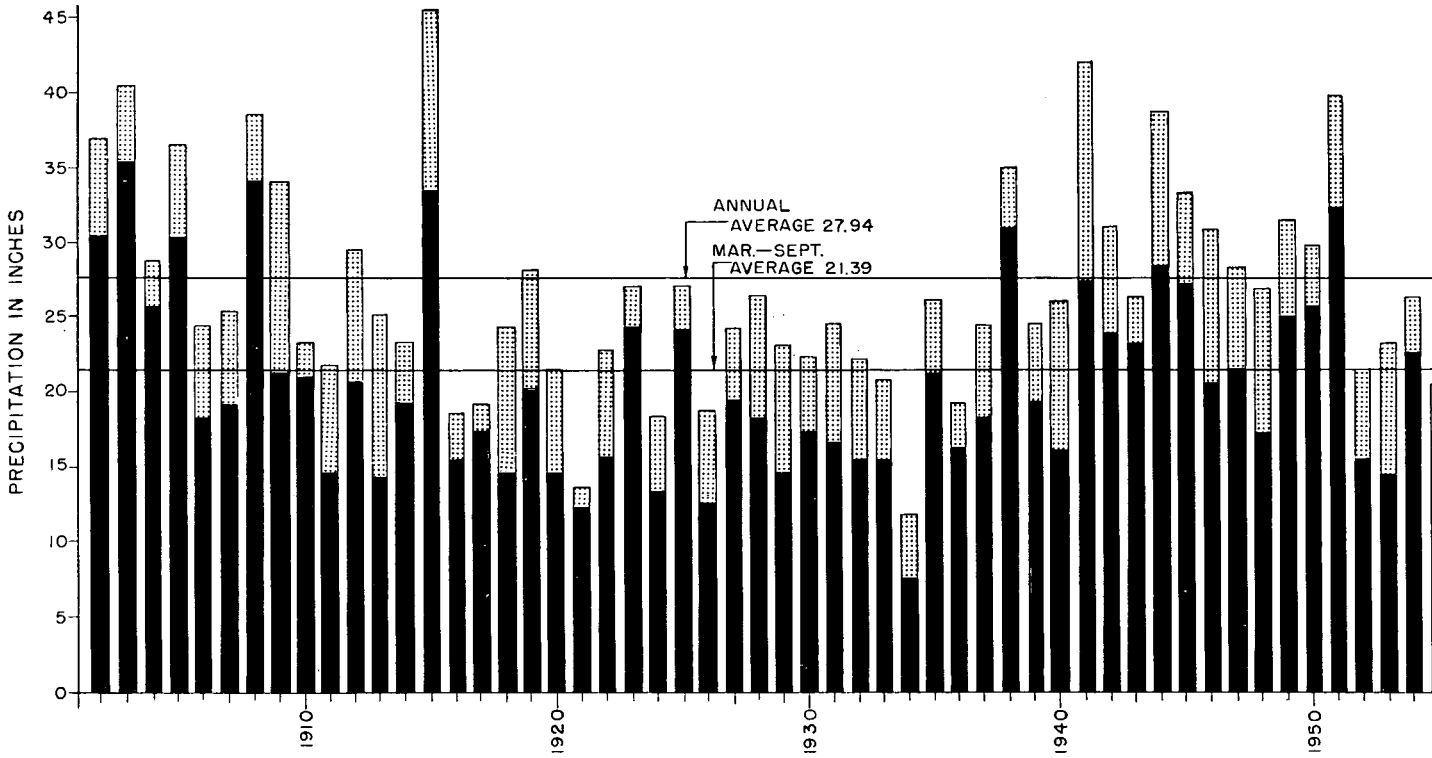


Figure 22.—**Annual precipitation and precipitation from March through September at Belleville, Kans., 1902–62. Black part of ba from March through September. Black part plus shaded part represents annual precipitation.**

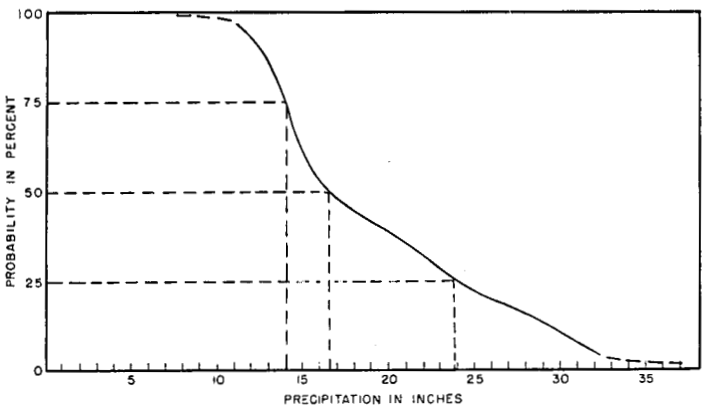


***Figure 23.*—Probability, in percent, of receiving at least the specified amounts of precipitation at Belleville, Kans., from April to September.**

Although blizzards are uncommon, in winter they are ominous threats to traffic and to livestock on the range. Glaze storms and heavy snows are also hazards to traffic in winter. Damage from lightning is mainly limited to livestock casualties and to power failures.

Agriculture

The early settlers brought with them the crops they had grown on the farms they left. Corn, spring wheat, oats, and barley were the main crops. Corn was the main cash crop and, by 1900, was grown on more than 180,000 acres. Wheat was also a cash crop. Cash crops and cattle farming have increased since 1900, and both are important today.

Table 10 lists the estimated acreage of the main crops grown in Republic County in stated years. The estimates were made by the Kansas State Board of Agriculture (*6*). In 1960 about 55 percent of the cultivated land was in clean-tilled crops, 35 percent was in small grain, and 10 percent was in alfalfa. Pasture and range in 1960 amounted to 129,000 acres.

TABLE 10.—*Estimated harvested acres of principal crops in stated years*

Crops	1930	1950	1960
Corn	150, 000	93, 200	67, 600
Sorghum:			
Grain	1, 000	4, 060	70, 000
Forage	4, 000	3, 460	4, 000
Wheat	27, 000	29, 780	85, 000
Oats	35, 000	23, 900	5, 300
Alfalfa	27, 000	29, 780	25, 000

Table 11 lists the number of livestock on farms and ranches in the county in stated years, as estimated by the Kansas State Board of Agriculture. As the grain and the pasture and range increased, beef cattle increased in number. Some beef cattle are now kept on almost all of the farms. Dairy herds are few, but many farmers sell some cream. Most hogs are kept for home use, but some farmers sell a few hogs, and there are a few producers of commercial swine.

TABLE 11.—*Estimated number of livestock on farms and ranches in stated years*

Livestock	1930	1950	1960
Beef cattle	24, 494	28, 770	37, 500
Milk cows	9, 533	7, 530	4, 500
Swine, including pigs	45, 478	36, 290	26, 200
Sheep and lambs	4, 220	3, 590	14, 300

Transportation and Markets

The Chicago, Rock Island, and Pacific Railroad crosses the middle of the county. In the valley of the Republican River, the Missouri Pacific Railroad has a branch line that extends to Kansas City. The Atchison, Topeka and Santa Fe Railway furnishes an outlet to Salina and points to the east. The Chicago, Burlington & Quincy Railroad runs to Chicago through the southeastern corner and the northern edge of the county. The Rock Island Lines furnish most of the passenger service in the county, and all lines have freight service.

U.S. Highways Nos. 81 and 36 cross at Belleville, the county seat, near the middle of the county. State Route 148 crosses the county from east to west and connects the towns of Kackley, Norway, Wayne, and Agenda. Hard-surfaced roads or good gravel roads connect all towns to the main highways that go into Belleville. Almost every square mile of the county is accessible by road during most of the year. A private airport, accommodating small planes, is located 1 mile west of Belleville along U.S. Highway No. 36.

Nearly every town in Republic County has a grain elevator that supplies business to the railroads and truckers. In most of the towns, dealers in seed, fertilizer, and farm machinery sell the products of these industries.

Literature Cited

(1) AMERICAN ASSOCIATION OF STATE HIGHWAY OFFICIALS.
1961. STANDARD SPECIFICATIONS FOR HIGHWAY MATERIALS AND METHODS OF SAMPLING AND TESTING. Ed. 8, 2 v., illus. Washington, D.C.

(2) BALDWIN, MARK, KELLOGG, CHARLES E., AND THORP, JAMES.
1938. SOIL CLASSIFICATION. U.S. Dept. Agr. Ybk., pp. 979–1001, illus.

(3) BARK, L. DEAN.
1963. CHANCES OF PRECIPITATION IN KANSAS. Agr. Expt. Sta., Kans. State Univ. Agr. and Applied Sci. Bul. 461, 83 pp., illus.

(4) FISHEL, V. C.
1948. GROUND WATER RESOURCES OF REPUBLIC COUNTY AND NORTHERN CLOUD COUNTY, KANSAS. State Geol. Survey of Kans. Bul. 73, p. 29.

(5) FLORA, S. D.
1948. CLIMATE OF KANSAS. Kans. State Board Agr., 320 pp., illus.

(6) KANSAS STATE BOARD OF AGRICULTURE.
1962. FARM FACTS. Kans. State Board Agr., 96 pp., illus.

(7) PORTLAND CEMENT ASSOCIATION.
1956. PCA PRIMER. 86 pp., illus.

(8) SIMONSON, ROY W.
1962. SOIL CLASSIFICATION IN THE UNITED STATES. Sci. 137: 1027–1034.

(9) SOIL SURVEY STAFF.
1960. SOIL CLASSIFICATION, A COMPREHENSIVE SYSTEM. U.S. Dept. Agr., 265 pp., illus. [Supplement issued in March 1967.]

(10) THORP, JAMES AND SMITH, GUY D.
1949. HIGHER CATEGORIES OF SOIL CLASSIFICATION: ORDER, SUBORDER, AND GREAT SOIL GROUP. Soil Sci. 67: 117–126.
(11) UNITED STATES DEPARTMENT OF AGRICULTURE.
1964. SOIL SURVEY, LOGAN COUNTY, KANS. Series 1959, No. 35, 78 pp., illus.
(12) UNITED STATES DEPARTMENT OF COMMERCE, WEATHER BUREAU.
1961. RAINFALL FREQUENCY ATLAS OF THE UNITED STATES FOR DURATION FROM 30 MINUTES TO 24 HOURS AND RETURN PERIODS FROM 1 TO 100 YEARS. Tech. Paper No. 40, 115 pp., illus.
(13) WATERWAYS EXPERIMENT STATION, CORPS OF ENGINEERS.
1953. THE UNIFIED SOIL CLASSIFICATION. Tech. Memo. 3–357, 2 v. and appendix.

Glossary

Alluvium. Soil material, such as sand, silt, or clay, that has been deposited on land by streams.

Bench. A steplike embankment of earth that has a flat top and steep downhill face and is constructed to control runoff and erosion. May be levelled to a grade suitable for irrigation.
Parallel.—A bench laid out in straight lines across the slope.
Contour.—A bench that follows the normal curve or contour of the land.

Colluvium. Soil material, rock fragments, or both, moved by creep, slide, or local wash and deposited at the base of steep slopes.

Consistence, soil. The feel of the soil and the ease with which a lump can be crushed by the fingers. Terms commonly used to describe consistence are—
Loose.—Noncoherent; will not hold together in a mass.
Friable.—When moist, crushes easily under gentle pressure between thumb and forefinger and can be pressed together into a lump.
Firm.—When moist, crushes under moderate pressure between thumb and forefinger, but resistance is distinctly noticeable.
Plastic.—When wet, readily deformed by moderate pressure but can be pressed into a lump; will form a "wire" when rolled between thumb and forefinger.
Sticky.—When wet, adheres to other material, and tends to stretch somewhat and pull apart, rather than to pull free from other material.
Hard.—When dry, moderately resistant to pressure; can be broken with difficulty between thumb and forefinger.
Soft.—When dry, breaks into powder or individual grains under very slight pressure.
Cemented.—Hard and brittle; little affected by moistening.

Flood plain. Nearly level land, consisting of stream sediments, subject to frequent or occasional flooding.

Genesis, soil. The manner in which a soil originated, with special reference to the processes responsible for the development of the solum, or true soil, from the unconsolidated parent material.

Loess. A fine-grained eolian deposit consisting dominantly of silt-sized particles.

Morphology, soil. The makeup of the soil, including the texture, structure, consistence, color, and other physical, mineralogical, and biological properties of the various horizons of the soil profile.

Parent material. The unconsolidated mass from which the soil profile develops.

Permeability. The quality of a soil horizon that enables water or air to move through it. Terms used to describe permeability are as follows: *very slow, slow, moderately slow, moderate, moderately rapid, rapid,* and *very rapid.*

Profile, soil. A vertical section of the soil extending from the surface into the parent material.

Reaction, soil. The degree of acidity or alkalinity of a soil, expressed in pH values. A soil that tests to pH 7.0 is precisely neutral in reaction because it is neither acid nor alkaline. An acid, or "sour," soil is one that gives an acid reaction; an alkaline soil is one that is alkaline in reaction. In words, the degrees of acidity or alkalinity are expressed thus:

	pH		*pH*
Extremely acid	Below 4. 5	Mildly alkaline	7. 4 to 7. 8
Very strongly acid	4. 5 to 5. 0	Moderately alkaline	7. 9 to 8. 4
Strongly acid	5. 1 to 5. 5	Strongly alkaline	8. 5 to 9. 0
Medium acid	5. 6 to 6. 0	Very strongly alkaline	9. 1 and higher
Slightly acid	6. 1 to 6. 5		
Neutral	6. 6 to 7. 3		

Solum. The upper part of a soil profile, above the parent material, in which the processes of soil formation are active. The solum in mature soil includes the A and B horizons. Generally, the characteristics of the material in these horizons are unlike those of the underlying parent material.

Structure, soil. The arrangement of primary soil particles into compound particles or clusters that are separated from adjoining aggregates and have properties unlike those of an equal mass of unaggregated primary soil particles. The principal forms of soil structure are—*platy* (laminated), *prismatic* (vertical axis of aggregates longer than horizontal), *columnar* (prisms with rounded tops), *blocky* (angular or subangular), and *granular. Structureless* soils are (1) *single grain* (each grain by itself, as in dune sand) or (2) *massive* (the particles adhering together without any regular cleavage, as in many claypans and hardpans).

Substratum. Any layer lying beneath the solum, or true soil; the C or D horizon.

Terrace (geological). An old alluvial plain, ordinarily flat or undulating, bordering a river, lake, or the sea. Stream terraces are frequently called second bottoms, as contrasted to flood plains, and are seldom subject to overflow. Marine terraces were deposited by the sea and are generally wide.

Texture, soil. The relative proportions of sand, silt, and clay particles in a mass of soil. The basic textural classes, in order of increasing proportions of fine particles, are *sand, loamy sand, sandy loam, loam, silt loam, silt, sandy clay loam, clay loam, silty clay loam, sandy clay, silty clay,* and *clay.* The sand, loamy sand, and sandy loam classes may be further divided by specifying "coarse," "fine," or "very fine."

U.S. GOVERNMENT PRINTING OFFICE: 1967

Accessibility Statement

This document is not accessible by screen-reader software. The Natural Resources Conservation Service (NRCS) is committed to making its information accessible to all of its customers and employees. If you are experiencing accessibility issues and need assistance, please contact our Helpdesk by phone at (800) 457-3642 or by e-mail at ServiceDesk-FTC@ftc.usda.gov. For assistance with publications that include maps, graphs, or similar forms of information, you may also wish to contact our State or local office. You can locate the correct office and phone number at http://offices.sc.egov.usda.gov/locator/app.

Nondiscrimination Statement

Nondiscrimination Policy

The U.S. Department of Agriculture (USDA) prohibits discrimination against its customers, employees, and applicants for employment on the basis of race, color, national origin, age, disability, sex, gender identity, religion, reprisal, and where applicable, political beliefs, marital status, familial or parental status, sexual orientation, whether all or part of an individual's income is derived from any public assistance program, or protected genetic information. The Department prohibits discrimination in employment or in any program or activity conducted or funded by the Department. (Not all prohibited bases apply to all programs and/or employment activities.)

To File an Employment Complaint

If you wish to file an employment complaint, you must contact your agency's EEO Counselor (http://directives.sc.egov.usda.gov/33081.wba) within 45 days of the date of the alleged discriminatory act, event, or personnel action. Additional information can be found online at http://www.ascr.usda.gov/complaint_filing_file.html.

To File a Program Complaint

If you wish to file a Civil Rights program complaint of discrimination, complete the USDA Program Discrimination Complaint Form, found online at http://www.ascr.usda.gov/complaint_filing_cust.html or at any USDA office, or call (866) 632-9992 to request the form. You may also write a letter containing all of the information requested in the form. Send your completed complaint form or letter by mail to U.S. Department of Agriculture; Director, Office of Adjudication; 1400 Independence Avenue, S.W.; Washington, D.C. 20250-9419; by fax to (202) 690-7442; or by email to program.intake@usda.gov.

Persons with Disabilities

If you are deaf, are hard of hearing, or have speech disabilities and you wish to file either an EEO or program complaint, please contact USDA through the Federal Relay Service at (800) 877-8339 or (800) 845-6136 (in Spanish).

If you have other disabilities and wish to file a program complaint, please see the contact information above. If you require alternative means of communication for

program information (e.g., Braille, large print, audiotape, etc.), please contact USDA's TARGET Center at (202) 720-2600 (voice and TDD).

Supplemental Nutrition Assistance Program

For additional information dealing with Supplemental Nutrition Assistance Program (SNAP) issues, call either the USDA SNAP Hotline Number at (800) 221-5689, which is also in Spanish, or the State Information/Hotline Numbers (http://directives.sc.egov.usda.gov/33085.wba).

All Other Inquiries

For information not pertaining to civil rights, please refer to the listing of the USDA Agencies and Offices (http://directives.sc.egov.usda.gov/33086.wba).

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
KANSAS AGRICULTURAL EXPERIMENT STATION

GENERAL SOIL MAP
REPUBLIC COUNTY, KANSAS

N

1 0 1 2 3 4 Miles

NUCKOLLS CO NEBRASKA 97°50′ THAYER BASE 97°40′ LINE 81 COUNTY 97°30′ NEBRASKA

40°00′

39°50′

39°40′

T. 1 S.

T. 2 S.

T. 3 S.

T. 4 S.

COUNTY

MERIDIAN

COUNTY

JEWELL

WASHINGTON

CLOUD COUNTY

R. 5 W. R. 4 W. R. 3 W. R. 2 W. R. 1 W.

Warwick
Harbine
Narka
Republic
Munden
Sherdahl
Rydal
BELLEVILLE
Haworth
Cuba
Courtland
Scandia
Kackley
Norway
Talmo
Wayne
Agenda
State Lake

C B & Q
PACIFIC
ISLAND AND
ROCK
CHICAGO
REPUBLICAN
CANAL
WHITE ROCK
MISSOURI
EXTENSION
COURTLAND
CANAL WEST
ATCHISON TOPEKA AND SANTA FE
BEAVER RIVER
BURLINGTON
QUINCY
PRINCIPAL

Creek
Spring Cr
Otter Creek
Rock Cr
White Rock Canal
Dry Creek
Mud Creek
Beaver Creek
School Creek
Rose Creek
Oak Creek
Stump Creek
St. Johns Creek
Camp Creek
Lost Cr
Riley Creek
West Salt Creek
Salt Creek
Cedar Creek
Cool Creek
East Cool Creek
Mill Creek
South Fork Mill Creek
Elk Creek
West Elk Creek
East Elk Creek
Cherry Creek

SOIL ASSOCIATIONS

1 Crete-Butler-Hastings association: Nearly level to undulating, deep soils developed in loess

2 Hastings-Crete-Geary association: Sloping to rolling, deep soils developed in loess and mixed materials

3 Kipson-Tully-Crete association: Rolling, deep and shallow soils developed in loess and limestone-shale materials

4 Lancaster-Hedville-Crete association: Sloping to rolling, deep and shallow soils developed in loess and sandstone-shale materials

5 Muir-Carr-Humbarger association: Nearly level to gently undulating soils formed in alluvium on flood plains and terraces

July 1966

INDEX TO MAP SHEETS
REPUBLIC COUNTY, KANSAS

N

1 0 1 2 3 4 Miles

NUCKOLLS CO NEBRASKA — THAYER BASE LINE — COUNTY NEBRASKA

97°50′ 97°40′ 97°30′ 40°00′ 39°50′ 39°40′

Warwick · Harbine · Republic · Sherdahl · Rydal · BELLEVILLE · Scandia · Courtland · Kackley · Norway · Talmo · Munden · Narka · Cuba · Haworth · Wayne · Agenda

C B & Q · CHICAGO ROCK ISLAND AND PACIFIC · REPUBLICAN CANAL · WHITE ROCK CANAL · WHITE ROCK CANAL EXTENSION · MISSOURI COURTLAND WEST CANAL · ATCHISON TOPEKA AND SANTA FE · CHICAGO QUINCY AND BURLINGTON · SOUTH FORK MILL CREEK · WEST ELK FORK · EAST ELK FORK · SALT CREEK · SCHOOL CREEK · RILEY CREEK · ROSE CREEK · DRY CREEK · MILLER CREEK · MUD CREEK · SPRING CREEK · OTTER CREEK · BEAVER CREEK · LOST CREEK · CAMP CREEK · OAK CREEK · STRAIGHT CREEK · STATE LAKE CREEK · ST JOHNS CREEK · CHERRY CREEK · MILL CREEK · ELK CREEK · COAL CREEK · WEST COAL CREEK · EAST COAL CREEK

1 2 3 4 5 6 7 8 · 9 10 11 12 13 14 15 16 · 17 18 19 20 21 22 23 · 24 25 26 27 28 29 30 · 31 32 33 34 35 36 37 38 · 39 40 41 42 43 44 45 46 · 47 48 49 50 51 52 53 · 54 55 56 57 58 59 60

T. 1 S. · T. 2 S. · T. 3 S. · T. 4 S.

R. 5 W. · R. 4 W. · R. 3 W. · R. 2 W. · R. 1 W.

CLOUD COUNTY · JEWELL COUNTY · WASHINGTON COUNTY · 6TH PRINCIPAL MERIDIAN

Inset, sheet 8

Inset, sheet 23

Inset, sheet 38

Inset, sheet 53

SOIL LEGEND

SYMBOL	NAME
Bk	Breaks–Alluvial land complex
Bu	Butler silt loam, thin surface variant
Ca	Carr fine sandy loam
Ce	Crete silt loam, 0 to 1 percent slopes
Cf	Crete silt loam, 1 to 3 percent slopes
Ch	Crete silty clay loam, 3 to 7 percent slopes
Cr	Crete silty clay loam, 2 to 5 percent slopes, eroded
Dt	Detroit silty clay loam
Ea	Englund silty clay loam, 3 to 7 percent slopes
Ed	Eudora loam, 0 to 2 percent slopes
Eu	Eudora loam, 2 to 8 percent slopes
Gc	Geary–Crete silt loams, 3 to 7 percent slopes
Gr	Geary–Crete silty clay loams, 3 to 7 percent slopes, severely eroded
Ha	Hastings silt loam, 0 to 1 percent slopes
Hb	Hastings silt loam, 1 to 3 percent slopes
Hc	Hastings silt loam, 3 to 7 percent slopes
Hd	Hastings silty clay loam, 3 to 7 percent slopes, eroded
He	Hastings and Crete soils, 3 to 7 percent slopes, severely eroded
Hf	Hastings–Ortello fine sandy loams, 1 to 4 percent slopes, eroded
Ho	Hastings–Ortello fine sandy loams, 4 to 8 percent slopes, eroded
Hp	Hastings soils, eroded–Hobbs complex
Hs	Hobbs silt loam
Ht	Humbarger clay loam
Hu	Humbarger loam
Ke	Kenesaw silt loam, 5 to 12 percent slopes
Kn	Kenesaw silt loam, 5 to 12 percent slopes, eroded
Kp	Kipson soils, 11 to 30 percent slopes
La	Lancaster loam, 4 to 8 percent slopes
Lc	Lancaster loam, 4 to 8 percent slopes, eroded
Lh	Lancaster–Hedville loams, 5 to 25 percent slopes
Mr	Muir silt loam, 0 to 1 percent slopes
Mu	Muir silt loam, 3 to 7 percent slopes, eroded
Ro	Rough broken land
Sa	Sarpy loamy fine sand
Sd	Sarpy soils, duned
Tu	Tully silty clay loam, 4 to 8 percent slopes
Ty	Tully silty clay loam, 4 to 8 percent slopes, eroded
Wa	Wet alluvial land

CONVENTIONAL SIGNS

WORKS AND STRUCTURES

Highways and roads
- Dual
- Good motor
- Poor motor
- Trail

Highway markers
- National Interstate
- U. S.
- State or county

Railroads
- Single track
- Multiple track
- Abandoned

Bridges and crossings
- Road
- Trail, foot
- Railroad
- Ferry (FY)
- Ford
- Grade
- R. R. over
- R. R. under
- Tunnel

Buildings
- School
- Church
- Station

Mines and Quarries
- Mine dump
- Pits, gravel or other

Power line

Pipeline

Cemetery

Dams

Levee

Tanks

Well, oil or gas

BOUNDARIES

- National or state
- County
- Township or range, U. S.
- Section line, corner, U. S.
- Reservation
- Land grant
- Small park, cemetery, airport

DRAINAGE

Streams
- Perennial
- Intermittent
- Crossable with tillage implements
- Not crossable with tillage implements

Canals and ditches (CANAL / DITCH)

Lakes and ponds
- Perennial
- Intermittent

Wells, water (flowing)

Springs

Marsh

Wet spot

Alluvial fan

Drainage end

RELIEF

Escarpments
- Bedrock
- Other

Prominent peak

Depressions

	Large	Small
Crossable with tillage implements		
Not crossable with tillage implements		
Contains water most of the time		

SOIL SURVEY DATA

- Soil boundary and symbol (Dx)
- Gravel
- Stones
- Rock outcrops
- Chert fragments
- Clay spot
- Sand spot
- Gumbo or scabby spot
- Made land
- Severely eroded spot
- Blowout, wind erosion
- Gully

Soil map constructed 1966 by Cartographic Division, Soil Conservation Service, USDA, from 1962 aerial photographs. Controlled mosaic based on Kansas plane coordinate system, north zone, Lambert conformal conic projection, 1927 North American datum.

GUIDE TO MAPPING UNITS

[For a full description of a mapping unit, read both the description of the mapping unit and the description of the soil series to which the mapping unit belongs.

[See table 1, page 10, for approximate acreage and proportionate extent of the soils; table 2, page 31, for predicted average yields per acre for principal dryland crops; and table 3, page 36, for suitability of trees and shrubs for planting windbreaks. For information significant to engineering, see subsection beginning on page 36]

Map symbol	Mapping unit	Described on page	Dryland capability unit		Irrigated capability unit		Range site		Windbreak suitability group
			Symbol	Page	Symbol	Page	Name	Page	Number
Bk	Breaks-Alluvial land complex--------	10							
	Breaks portion----------	--	VIe-2	28	None	--	Loamy Upland	33	3
	Alluvial land portion----------	--	VIe-2	28	None	--	Loamy Lowland	32	1
Bu	Butler silt loam, thin surface variant----------	11	IIs-2	25	IIs-3	29	Clay Upland	33	3
Ca	Carr fine sandy loam----------	11	IIw-1	25	IIw-2	29	Sandy Lowland	33	2
Ce	Crete silt loam, 0 to 1 percent slopes----------	12	IIs-1	25	IIs-3	29	Clay Upland	33	3
Cf	Crete silt loam, 1 to 3 percent slopes----------	12	IIe-1	24	IIe-3	28	Clay Upland	33	3
Ch	Crete silty clay loam, 3 to 7 percent slopes----------	12	IIIe-4	26	IIIe-5	29	Clay Upland	33	3
Cr	Crete silty clay loam, 2 to 5 percent slopes, eroded----------	12	IIIe-1	25	IIIe-5	29	Clay Upland	33	3
Dt	Detroit silty clay loam----------	13	IIs-1	25	I-2	28	Loamy Lowland	32	1
Ea	Englund silty clay loam, 3 to 7 percent slopes----------	13	IIIe-4	26	None	--	Clay Upland	33	3
Ed	Eudora loam, 0 to 2 percent slopes--	13	I-1	24	I-2	28	Loamy Lowland	32	1
Eu	Eudora loam, 2 to 8 percent slopes--	13	IIIe-3	26	IIIe-6	29	Loamy Lowland	32	1
Gc	Geary-Crete silt loams, 3 to 7 percent slopes----------	14							
	Geary portion----------	--	IIIe-4	26	IIIe-5	29	Loamy Upland	33	3
	Crete portion----------	--	IIIe-4	26	IIIe-5	29	Clay Upland	33	3
Gr	Geary-Crete silty clay loams, 3 to 7 percent slopes, severely eroded---	14							
	Geary portion----------	--	IVe-1	27	IVe-4	30	Loamy Upland	33	3
	Crete portion----------	--	IVe-1	27	IVe-4	30	Clay Upland	33	3
Ha	Hastings silt loam, 0 to 1 percent slopes----------	15	I-1	24	I-2	28	Loamy Upland	33	3
Hb	Hastings silt loam, 1 to 3 percent slopes----------	15	IIe-2	24	IIe-3	28	Loamy Upland	33	3
Hc	Hastings silt loam, 3 to 7 percent slopes----------	15	IIIe-4	26	IIIe-5	29	Loamy Upland	33	3
Hd	Hastings silty clay loam, 3 to 7 percent slopes, eroded----------	15	IIIe-1	25	IIIe-5	29	Loamy Upland	33	3
He	Hastings and Crete soils, 3 to 7 percent slopes, severely eroded---	16							
	Hastings portion----------	--	IVe-1	27	IVe-4	30	Loamy Upland	33	3
	Crete portion----------	--	IVe-1	27	IVe-4	30	Clay Upland	33	3
Hf	Hastings-Ortello fine sandy loams, 1 to 4 percent slopes, eroded---	16	IIIe-1	25	IIIe-5	29	Sandy	34	3
Ho	Hastings-Ortello fine sandy loams, 4 to 8 percent slopes, eroded---	16	IIIe-1	25	IIIe-5	29	Sandy	34	3
Hp	Hastings soils, eroded-Hobbs complex----------	16							
	Hastings portion----------	--	IVe-1	27	IVe-4	30	Loamy Upland	33	3
	Hobbs portion----------	--	IIw-1	25	IIw-2	29	Loamy Lowland	32	1
Hs	Hobbs silt loam----------	17	IIw-1	25	IIw-2	29	Loamy Lowland	32	1
Ht	Humbarger clay loam----------	18	IIIw-1	26	IIw-2	29	Loamy Lowland	32	1
Hu	Humbarger loam----------	18	IIw-1	25	IIw-2	29	Loamy Lowland	32	1
Ke	Kenesaw silt loam, 5 to 12 percent slopes----------	18	IVe-2	27	IIIe-6	29	Loamy Upland	33	3
Kn	Kenesaw silt loam, 5 to 12 percent slopes, eroded----------	18	IVe-2	27	IIIe-6	29	Loamy Upland	33	3
Kp	Kipson soils, 11 to 30 percent slopes----------	19	VIe-1	27	None	--	Breaks	34	4
La	Lancaster loam, 4 to 8 percent slopes----------	19	IIIe-2	26	IIIe-5	29	Loamy Upland	33	3
Lc	Lancaster loam, 4 to 8 percent slopes, eroded----------	19	IIIe-2	26	IIIe-5	29	Loamy Upland	33	3
Lh	Lancaster-Hedville loams, 5 to 25 percent slopes----------	20							
	Lancaster portion----------	--	VIe-1	27	None	--	Loamy Upland	33	3
	Hedville portion----------	--	VIe-1	27	None	--	Breaks	34	4
Mr	Muir silt loam, 0 to 1 percent slopes----------	20	I-1	24	I-2	28	Loamy Lowland	32	1
Mu	Muir silt loam, 3 to 7 percent slopes, eroded----------	21	IIIe-3	26	IIIe-6	29	Loamy Lowland	32	1
Ro	Rough broken land----------	21	VIIe-1	28	None	--	Loamy Upland	33	3
Sa	Sarpy loamy fine sand----------	21	IIIw-2	27	IIIw-4	30	Sandy Lowland	33	2
Sd	Sarpy soils, duned----------	21	VIe-3	28	None	--	Sands	34	2
Tu	Tully silty clay loam, 4 to 8 percent slopes----------	22	IIIe-4	26	IIIe-5	29	Loamy Upland	33	3
Ty	Tully silty clay loam, 4 to 8 percent slopes, eroded----------	22	IIIe-1	25	IIIe-5	29	Loamy Upland	33	3
Wa	Wet alluvial land----------	22	Vw-1	27	None	--	Subirrigated	32	1

234-641 O - 67 (Face blank p. 62)

REPUBLIC COUNTY, KANSAS — SHEET NUMBER 1

This map is one of a set compiled in 1965 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the Kansas Agricultural Experiment Station.

Range, township, and section corners shown on this map are indefinite.

NUCKOLLS COUNTY

R. 5 W.

NEBRASKA

JEWELL COUNTY

T. 1 S.

Warwick

BASE LINE

CHICAGO, BURLINGTON AND QUINCY

MISSOURI PACIFIC

REPUBLICAN RIVER

CANAL

ROSEMOUND CEMETERY

Rosemound School

6 5 4 3 2 1

7 8 9 10

18 17 16 15

(Joins sheet 2)

(Joins sheet 9)

N

0 ½ 1 Mile

Scale 1:20 000

0 5000 Feet

REPUBLIC COUNTY, KANSAS — SHEET NUMBER 2

NUCKOLLS COUNTY | R. 5 W. | R. 4 W. | THAYER COUNTY | NEBRASKA

BASE LINE

QUINCY

BURLINGTON AND CHICAGO

Otter Creek

LAKE CEMETERY

MISSOURI PACIFIC

T. 1 S.

(Joins sheet 1)

(Joins sheet 3)

(Joins sheet 10)

0 ½ 1 Mile

Scale 1:20 000

0 5000 Feet

REPUBLIC COUNTY, KANSAS — SHEET NUMBER 3

This map is one of a set compiled in 1965 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the Kansas Agricultural Experiment Station.

Range, township, and section corners shown on this map are indefinite.

THAYER COUNTY

R. 4 W.

BASE LINE

NEBRASKA

3

N

Harbine

Washington Center School

Otter Cr.

T. 1 S.

(Joins sheet 2)

(Joins sheet 4)

(Joins sheet 11)

0 ½ 1 Mile

Scale 1:20 000

0 5000 Feet

REPUBLIC COUNTY, KANSAS — SHEET NUMBER 4

4

N

THAYER COUNTY

R. 3 W.

BASE LINE

NEBRASKA

T. 1 S.

(Joins sheet 3)

(Joins sheet 5)

(Joins sheet 12)

6 5 4 3

7 8 9 10

18 17 16 15

Scale 1:20 000

0 ½ 1 Mile

0 5000 Feet

REPUBLIC COUNTY, KANSAS — SHEET NUMBER 5

THAYER COUNTY

R. 3 W. | R. 2 W.

NEBRASKA

BASE LINE

CHICAGO BURLINGTON AND QUINCY

T. 1 S.

District 66 School

Rose Creek

(Joins sheet 4)

(Joins sheet 6)

(Joins sheet 13)

N

5

0 ½ 1 Mile

Scale 1:20 000

0 5000 Feet

This map is one of a set compiled in 1965 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the Kansas Agricultural Experiment Station.

Range, township, and section corners shown on this map are indefinite.

6

N

THAYER COUNTY

R. 2 W.

NEBRASKA

BASE LINE

HUBBELL CEMETERY

QUINCY

BURLINGTON

CHICAGO

Rose Creek

T. 1 S.

(Joins sheet 5)

(Joins sheet 7)

(Joins sheet 14)

0 ½ 1 Mile

Scale 1:20 000

0 5000 Feet

This map is one of a set compiled in 1965 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the Kansas Agricultural Experiment Station.

Range, township, and section corners shown on this map are indefinite.

8

N

THAYER COUNTY

R. 1 W.

NEBRASKA

BASE LINE

2

1

11

12

14

13

PACIFIC

CHICAGO ROCK ISLAND AND

PRINCIPAL MERIDIAN

SIXTH PRINCIPAL MERIDIAN

WASHINGTON COUNTY

T. 1 S.

(Joins sheet 7)

(Joins upper right)

(Joins lower left)

R. 1 W.

23

24

26

25

35

36

Round Grove School

(Joins sheet 15)

(Joins sheet 23)

0 ½ 1 Mile

Scale 1:20 000

0 5000 Feet

This map is one of a set compiled in 1965 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the Kansas Agricultural Experiment Station.

Range, township, and section corners shown on this map are indefinite.

R. 5 W.

(Joins sheet 1)

9

N

T. 1 S.

JEWELL COUNTY

CANAL

REPUBLICAN RIVER

Spring Creek

Rock Creek

White Rock Creek

ROCK CANAL

REPUBLICAN R

Stover School

19 20 21 22 27 28 29 30 31 32 33 34

(Joins sheet 10)

(Joins sheet 16)

0 ½ 1 Mile

Scale 1:20 000

0 5000 Feet

REPUBLIC COUNTY, KANSAS — SHEET NUMBER 10

(10)

(Joins sheet 2)

R. 5 W. | R. 4 W.

N

T. 1 S.

(Joins sheet 9)

(Joins sheet 11)

(Joins sheet 17)

Republic

MISSOURI PACIFIC

REPUBLICAN RIVER

CANAL

Otter Creek

Otter Creek

UNDERGROUND AQUEDUCT (IRRIGATION)

0 ½ 1 Mile

Scale 1:20 000

0 5000 Feet

REPUBLIC COUNTY, KANSAS — SHEET NUMBER 11

This map is one of a set compiled in 1965 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the Kansas Agricultural Experiment Station.

Range, township, and section corners shown on this map are indefinite.

R. 4 W.

T. 1 S.

(Joins sheet 3)

(Joins sheet 10)

(Joins sheet 12)

(Joins sheet 18)

WASHINGTON CEMETERY

Dry Creek

21 22 23 24

28 27 26 25

33 34 35 36

0 ½ 1 Mile

Scale 1:20 000

0 5000 Feet

N

12

(Joins sheet 4)

R. 3 W.

T. 1 S.

N

Liberty Center

LIBERTY CEMETERY

19 20 21 22

30 29 28 27

31 32 33 34

(Joins sheet 11)

(Joins sheet 13)

(Joins sheet 19)

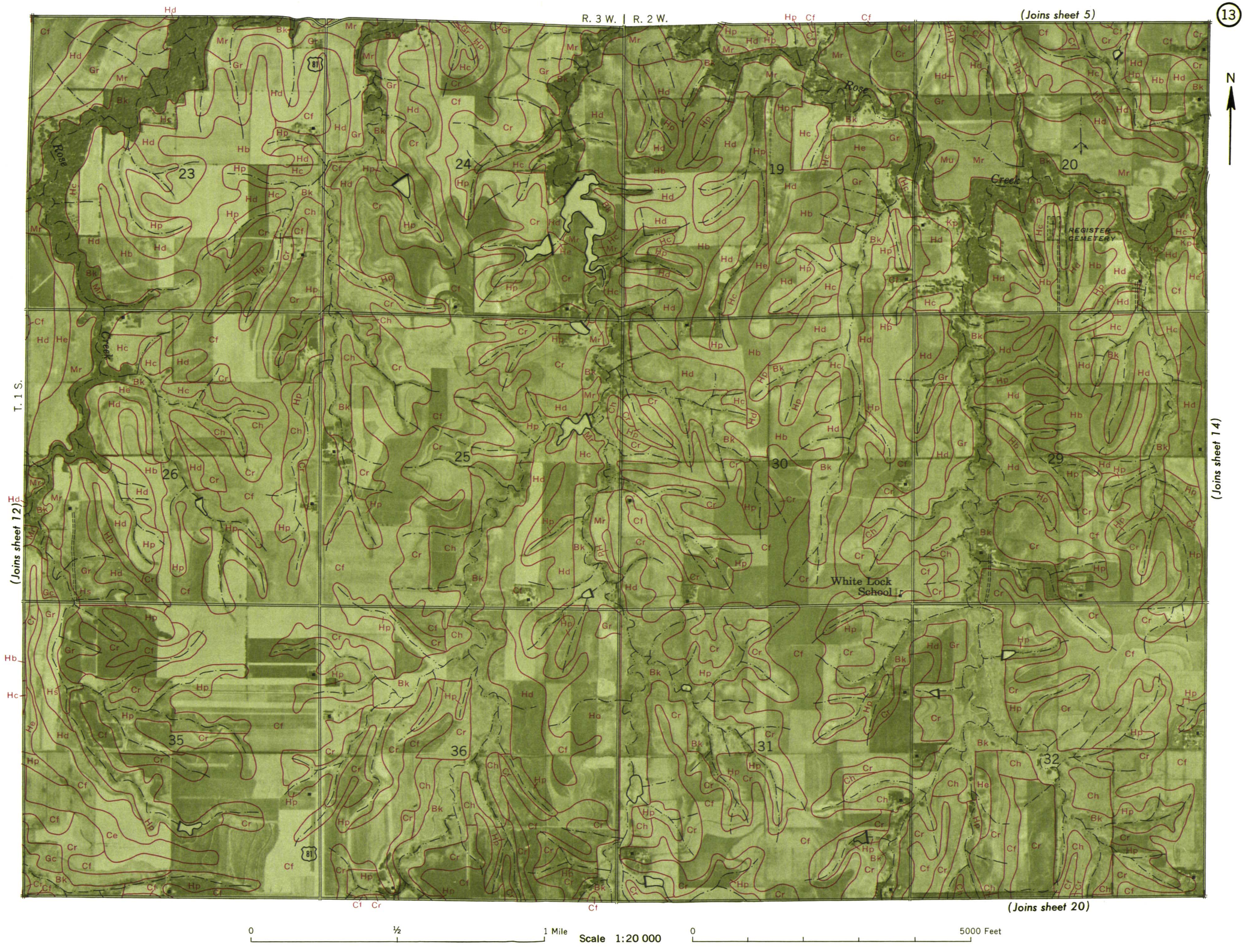
0 ½ 1 Mile

Scale 1:20 000

0 5000 Feet

This map is one of a set compiled in 1965 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the Kansas Agricultural Experiment Station.

Range, township, and section corners shown on this map are indefinite.



0 ½ 1 Mile Scale 1:20 000 0 5000 Feet

14

N

(Joins sheet 6)

R. 2 W.

T. 1 S.

(Joins sheet 13)

(Joins sheet 15)

(Joins sheet 21)

Rose Creek

Ida

IDA CEMETERY

Munden

PACIFIC AND ROCK ISLAND CHICAGO

21 22 23 24

28 27 26 25

33 34 35 36

0 ½ 1 Mile

Scale 1:20 000

0 5000 Feet

REPUBLIC COUNTY, KANSAS — SHEET NUMBER 15

This map is one of a set compiled in 1965 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the Kansas Agricultural Experiment Station.

Range, township, and section corners shown on this map are indefinite.

R. 1 W.

T. 1 S.

(Joins sheet 7)

(Joins sheet 14)

(Joins inset, sheet 8)

(Joins sheet 22)

Narka

PACIFIC AND ROCK ISLAND CHICAGO

19 20 21 22

30 29 28 27

31 32 33 34

15

N

0 ½ 1 Mile

Scale 1:20 000

0 5000 Feet

16

(Joins sheet 9)

R. 5 W.

N

COUNTY

JEWELL

T. 2 S.

(Joins sheet 17)

(Joins sheet 24)

White Rock

Rock Creek

WHITE ROCK CANAL

REPUBLICAN R OVERHEAD AQUEDUCT

CANAL

ROCK

WHITE

GRITTEN CEMETERY

WHITE ROCK CEMETERY

MILLER

0 ½ 1 Mile

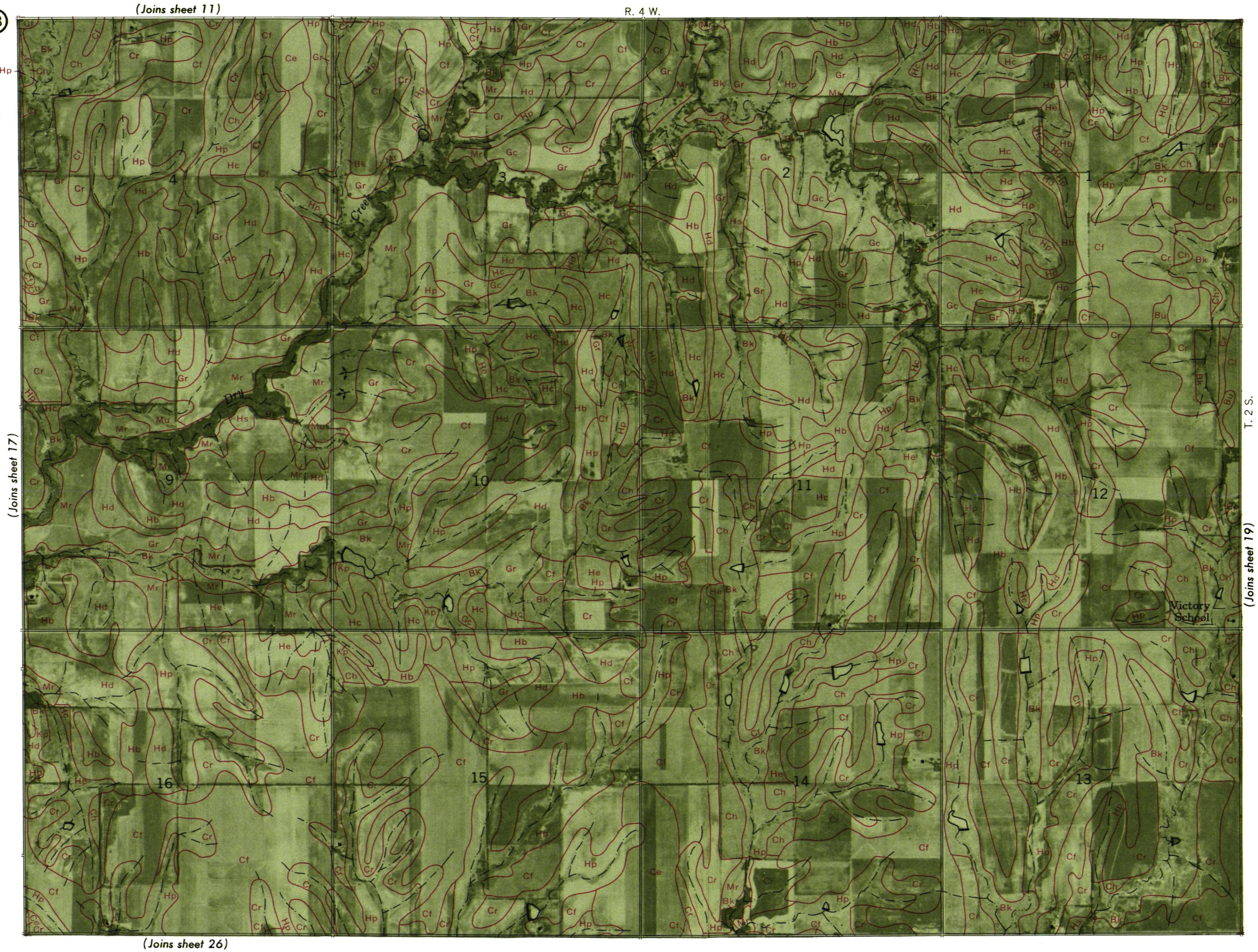
Scale 1:20 000

0 5000 Feet

This map is one of a set compiled in 1965 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the Kansas Agricultural Experiment Station.

Range, township, and section corners shown on this map are indefinite.

0 ½ 1 Mile Scale 1:20 000 0 5000 Feet



0 ½ 1 Mile

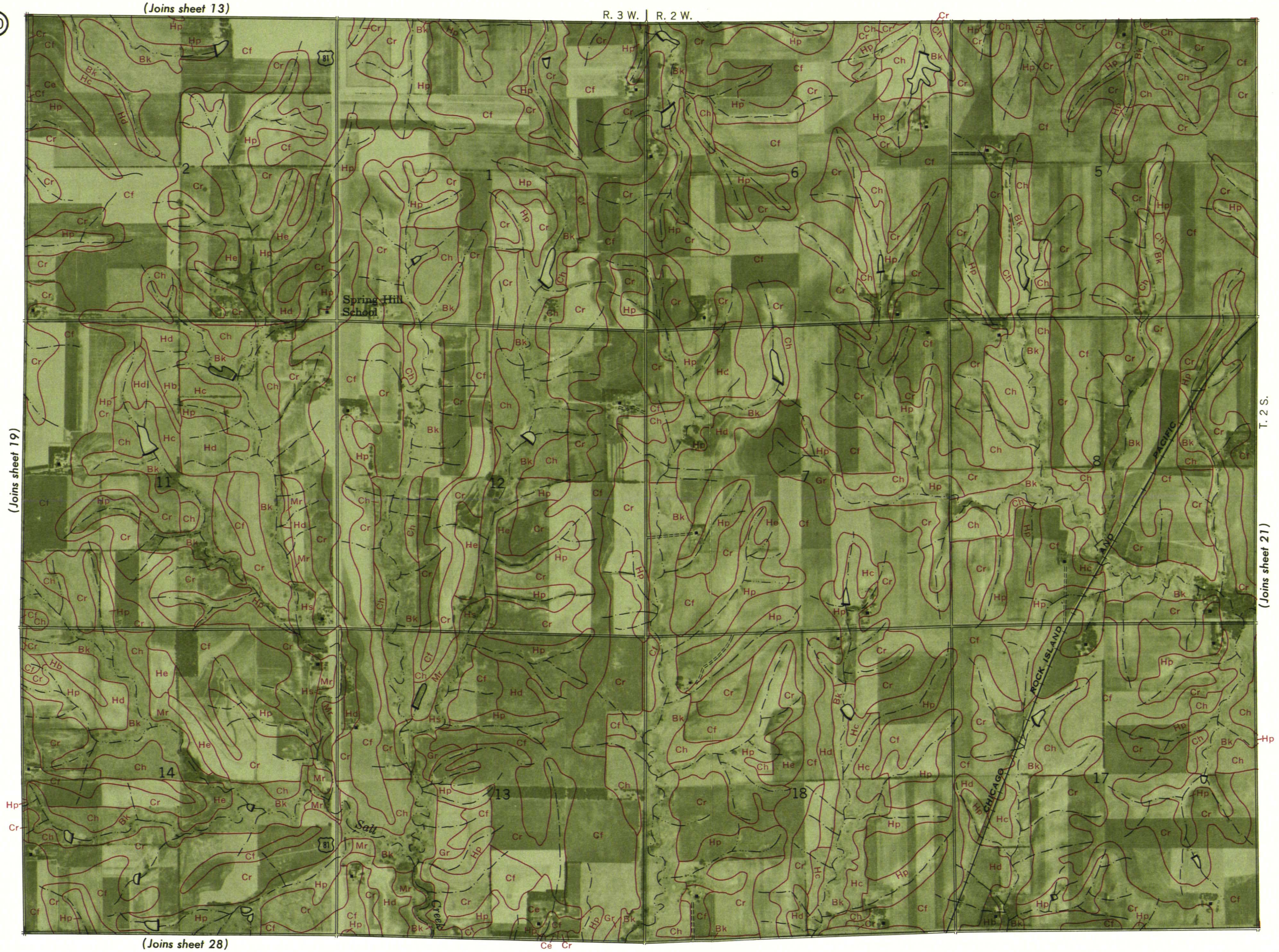
Scale 1:20 000

0 5000 Feet

REPUBLIC COUNTY, KANSAS — SHEET NUMBER 19

This map is one of a set compiled in 1965 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the Kansas Agricultural Experiment Station.

Range, township, and section corners on this map are indefinite.



0 ½ 1 Mile Scale 1:20 000 0 5000 Feet

REPUBLIC COUNTY, KANSAS — SHEET NUMBER 21

(Joins sheet 14)

R. 2 W.

21

N

Munden

CHICAGO, ROCK ISLAND AND PACIFIC

T. 2 S.

(Joins sheet 20)

(Joins sheet 22)

(Joins sheet 29)

Mill Creek

0 ½ 1 Mile

Scale 1:20 000

0 5000 Feet

This map is one of a set compiled in 1965 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the Kansas Agricultural Experiment Station.

Range, township, and section corners shown on this map are indefinite.

REPUBLIC COUNTY, KANSAS — SHEET NUMBER 22

22

N

(Joins sheet 15)

R. 1 W.

T. 2 S.

(Joins sheet 21)

(Joins sheet 23)

(Joins sheet 30)

Bethlehem School

NATIONAL CEMETERY

Mill Creek

6 5 4 3

7 8 9 10

18 17 16 15

0 ½ 1 Mile

Scale 1:20 000

0 5000 Feet

This map is one of a set compiled in 1965 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the Kansas Agricultural Experiment Station.

Range, township, and section corners shown on this map are indefinite.

0 ½ 1 Mile Scale 1:20 000 0 5000 Feet

24

N

(Joins sheet 16)

R. 5 W.

T. 2 S.

JEWELL COUNTY

(Joins sheet 25)

(Joins sheet 31)

19 20 21 22 30 29 28 27 31 32 33 34

CANAL

MILLER

WEST COURTLAND

COURTLAND

CANAL

Mud Creek

MCDONALD CEMETERY

0 ½ 1 Mile

Scale 1:20 000

0 5000 Feet

REPUBLIC COUNTY, KANSAS — SHEET NUMBER 25

This map is one of a set compiled in 1965 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the Kansas Agricultural Experiment Station.

Range, township, and section corners shown on this map are indefinite.

0 ½ 1 Mile

Scale 1:20 000

0 5000 Feet

26

(Joins sheet 18)

R. 4 W.

N

T. 2 S.

(Joins sheet 25)

(Joins sheet 27)

(Joins sheet 33)

Union Valley School

Creek

School

0 ½ 1 Mile

Scale 1:20 000

0 5000 Feet

REPUBLIC COUNTY, KANSAS — SHEET NUMBER 27

This map is one of a set compiled in 1965 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the Kansas Agricultural Experiment Station.

Range, township, and section corners shown on this map are indefinite.

0 ½ 1 Mile

Scale 1:20 000

0 5000 Feet

28

(Joins sheet 20)

R. 3 W. | R. 2 W.

N

T. 2 S.

(Joins sheet 27)

(Joins sheet 29)

(Joins sheet 35)

BELLEVILLE

Salt Creek

ROCK ISLAND AND PACIFIC

CHICAGO AND PACIFIC

ROCK ISLAND AND CHICAGO

81

23 24 19 20

26 25 30 29

35 36 31 32

0 ½ 1 Mile

Scale 1:20,000

0 5000 Feet

REPUBLIC COUNTY, KANSAS — SHEET NUMBER 29

0 ½ 1 Mile

Scale 1:20 000

0 5000 Feet

This map is one of a set compiled in 1965 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the Kansas Agricultural Experiment Station.

Range, township, and section corners shown on this map are indefinite.

30

N

(Joins sheet 22)

R. 1 W.

T. 2 S.

(Joins sheet 29)

(Joins inset, sheet 23)

(Joins sheet 37)

Eureka School

FARMINGTON CEMETERY

Mill Creek

South Fork

CHICAGO BURLINGTON AND QUINCY

0 ½ 1 Mile

Scale 1:20 000

0 5000 Feet

REPUBLIC COUNTY, KANSAS — SHEET NUMBER 31

This map is one of a set compiled in 1965 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the Kansas Agricultural Experiment Station.

Range, township, and section corners shown on this map are indefinite.

R. 5 W.

(Joins sheet 24)

31

N

T. 3 S.

JEWELL COUNTY

COURTLAND

ATCHISON TOPEKA AND SANTA FE

WEST CANAL

CANAL

Beaver Creek

Courtland

(Joins sheet 32)

(Joins sheet 39)

Scale 1:20 000

0 ½ 1 Mile

0 5000 Feet

32

(Joins sheet 25)

R. 5 W. | R. 4 W.

N

T. 3 S.

(Joins sheet 31)

(Joins sheet 33)

(Joins sheet 40)

Little Brick School

Mud Creek

Mud Creek

Mud Creek

REPUBLICAN

MISSOURI

PACIFIC

RIVER

CANAL

CANAL

COURTLAND

RIVER VIEW CEMETERY

Scandia

SEWAGE PLANT

GRAVEL PIT

ROCK ISLAND AND PACIFIC

CHICAGO

BP

0 ½ 1 Mile

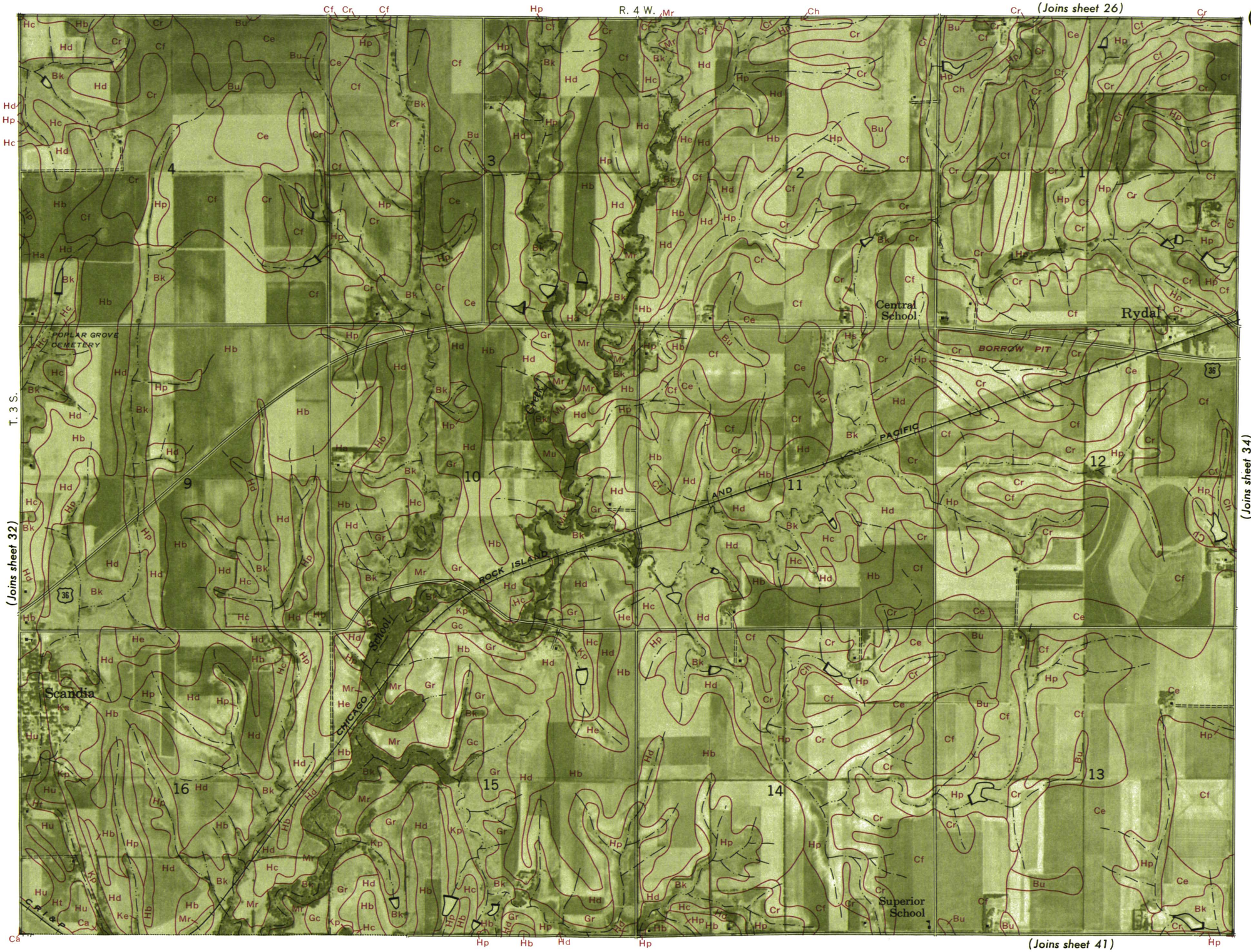
Scale 1:20 000

0 5000 Feet

REPUBLIC COUNTY, KANSAS — SHEET NUMBER 33

This map is one of a set compiled in 1965 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the Kansas Agricultural Experiment Station.

Range, township, and section corners shown on this map are indefinite.



0 ½ 1 Mile

Scale 1:20 000

0 5000 Feet

34
N
(Joins sheet 27)
R. 3 W.
T. 3 S.
(Joins sheet 33)
(Joins sheet 35)
(Joins sheet 42)
ST JOSEPHAT CEMETERY
PACIFIC AND ROCK ISLAND
CHICAGO
BELLEVILLE
BELLEVILLE AIRPORT
COUNTY CEMETERY
BORROW PIT
Summit Point School
Belleville Center School
Salt Creek
West Creek
Rattlesnake Creek
6
5
4
3
7
8
9
10
18
17
16
15
0 ½ 1 Mile
Scale 1:20 000
0 5000 Feet

This map is one of a set compiled in 1965 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the Kansas Agricultural Experiment Station.

Range, township, and section corners shown on this map are indefinite.

R. 3 W. | R. 2 W.

(Joins sheet 28)

35

N

BELLEVILLE

McCune School

T. 3 S.

(Joins sheet 34)

(Joins sheet 36)

(Joins sheet 43)

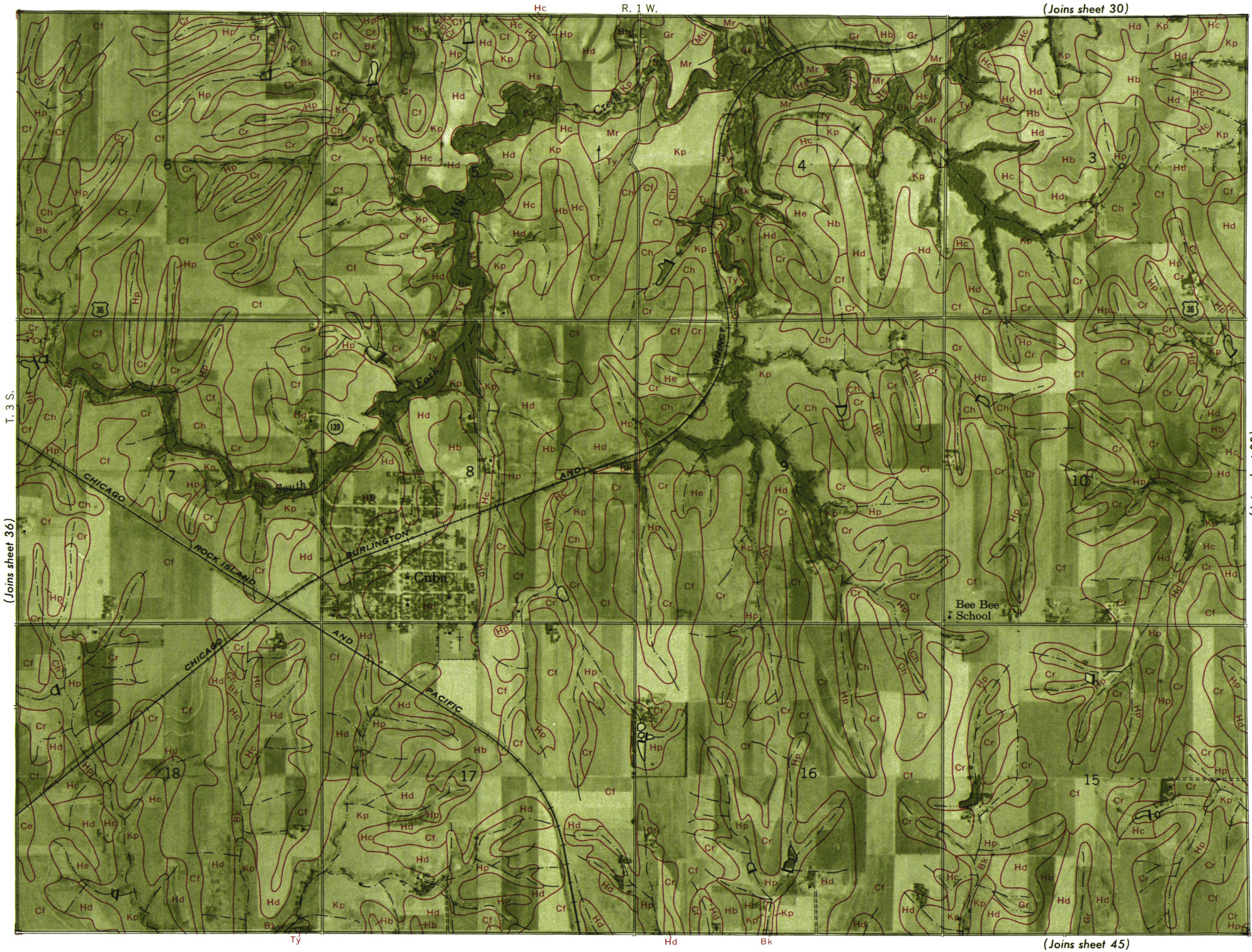
0 ½ 1 Mile

Scale 1:20 000

0 5000 Feet

36
(Joins sheet 29)
R. 2 W.
T. 3 S.
N
Prairie Home School
CHICAGO, ROCK ISLAND AND PACIFIC
South Fork Mill Cr.
District 20 School
(Joins sheet 35)
(Joins sheet 37)
(Joins sheet 44)
1
2
3
4
9
10
11
12
13
14
15
16
0
½
1 Mile
Scale 1:20 000
0
5000 Feet

REPUBLIC COUNTY, KANSAS — SHEET NUMBER 37



0 ½ 1 Mile Scale 1:20 000 0 5000 Feet

This map is one of a set compiled in 1965 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the Kansas Agricultural Experiment Station.

Range, township, and section corners shown on this map are indefinite.

38

N

(Joins inset, sheet 23)

R. 1 W.

(Joins sheet 37)

T. 3 S.

WASHINGTON COUNTY

SIXTH PRINCIPAL MERIDIAN

Bates School

HAWKS CEMETERY

(Joins upper right)

(Joins lower left)

(Joins sheet 45)

Fruit Hill Church

(Joins sheet 53)

0 ½ 1 Mile

Scale 1:20 000

0 5000 Feet

REPUBLIC COUNTY, KANSAS — SHEET NUMBER 39

This map is one of a set compiled in 1965 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the Kansas Agricultural Experiment Station.

Range, township, and section corners shown on this map are indefinite.

R. 5 W.

(Joins sheet 31)

39

N

T. 3 S.

JEWELL COUNTY

Courtland

COURTLAND CEMETERY

CHICAGO ROCK ISLAND AND PACIFIC

ATCHISON TOPEKA AND SANTA FE

CANAL

Beaver Creek

19 20 21 22

30 29 28 27

31 32 33 34

(Joins sheet 40)

(Joins sheet 46)

0 ½ 1 Mile

Scale 1:20 000

0 5000 Feet

40

0 ½ 1 Mile

Scale 1:20 000

0 5000 Feet

(Joins sheet 33)

R. 4 W.

T. 3 S.

N

(Joins sheet 40)

(Joins sheet 42)

(Joins sheet 48)

0 ½ 1 Mile

Scale 1:20 000

0 5000 Feet

This map is one of a set compiled in 1965 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the Kansas Agricultural Experiment Station.

Range, township, and section corners shown on this map are indefinite.

42

(Joins sheet 34)

R. 3 W.

T. 3 S.

N

Dunkard Church

Bowling Green School

Grace Hill School

West Salt Creek

19 20 21 22

30 29 28 27

31 32 33 34

81

(Joins sheet 41)

(Joins sheet 43)

(Joins sheet 49)

0 1 Mile Scale 1:20 000 0 5000 Feet

This map is one of a set compiled in 1965 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the Kansas Agricultural Experiment Station.

Range, township, and section corners shown on this map are indefinite.

0 ½ 1 Mile

Scale 1:20 000

0 5000 Feet

(Joins sheet 36)

R. 2 W.

T. 3 S.

(Joins sheet 43)

(Joins sheet 45)

(Joins sheet 51)

0 ½ 1 Mile

Scale 1:20 000

0 5000 Feet

REPUBLIC COUNTY, KANSAS — SHEET NUMBER 45

This map is one of a set compiled in 1965 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the Kansas Agricultural Experiment Station.

Range, township, and section corners shown on this map are indefinite.

R. 1 W.

T. 3 S.

(Joins sheet 37)

(Joins sheet 44)

(Joins inset, sheet 38)

(Joins sheet 52)

45

N

KOPSA CEMETERY

Thomas School

CHICAGO, ROCK ISLAND AND PACIFIC

Elk Creek

Mud Creek

Scale 1:20 000

0 ½ 1 Mile

0 5000 Feet

46

(Joins sheet 39)

R. 5 W.

N

JEWELL COUNTY

T. 4 S.

CANAL

ATCHISON TOPEKA AND SANTA FE

Ada Church

Kackley

(Joins sheet 47)

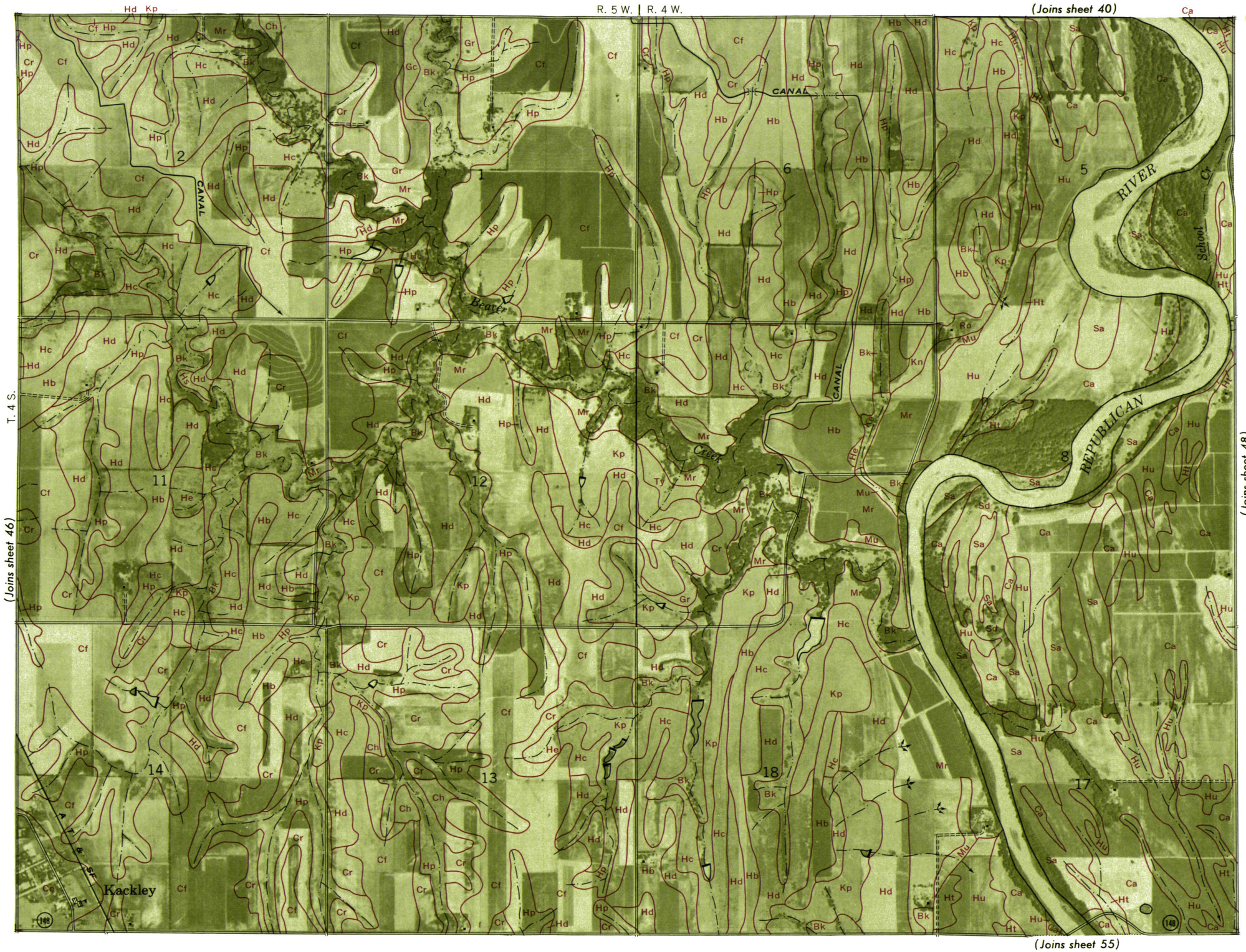
(Joins sheet 54)

0 ½ 1 Mile

Scale 1:20 000

0 5000 Feet

REPUBLIC COUNTY, KANSAS — SHEET NUMBER 47



This map is one of a set compiled in 1965 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the Kansas Agricultural Experiment Station.

Range, township, and section corners shown on this map are indefinite.

(Joins sheet 41)
R. 4 W.
T. 4 S.
(Joins sheet 47)
(Joins sheet 49)
(Joins sheet 56)
N
Schoo
MISSOURI
PACIFIC
Creek
Lost
PLEASANT RIDGE CEMETERY
Norway
District 48 School
4
3
2
1
9
10
11
12
16
15
14
13
Ht Hu Eu Ed Dt Mr Ca Sa Bk Kp Kn Ke Hc Hd Hb Hs He Hp Cf Ce Cr Ch Bu Ty Md
0 ½ 1 Mile
Scale 1:20 000
0 5000 Feet

This map is one of a set compiled in 1965 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the Kansas Agricultural Experiment Station.

Range, township, and section corners shown on this map are indefinite.

0 ½ 1 Mile

Scale 1:20 000

0 5000 Feet

(Joins sheet 43)

R. 3 W. | R. 2 W.

T. 4 S.

(Joins sheet 49)

(Joins sheet 51)

(Joins sheet 58)

N

Riley Cr.

Coon Creek

Mud Creek

Salt Creek

PLEASANT HILL CEMETERY

Talmo

148

0 ½ 1 Mile

Scale 1:20 000

0 5000 Feet

REPUBLIC COUNTY, KANSAS — SHEET NUMBER 51

R. 2 W.

(Joins sheet 44)

51

N

T. 4 S.

(Joins sheet 50)

(Joins sheet 52)

(Joins sheet 59)

Wayne

Turkey Creek School

UNION CEMETERY

CHICAGO, BURLINGTON AND QUINCY

Cool Creek

Cool Creek

Cool Creek

Cool Creek

Cool Creek

Cool Creek

148

148

148

0 ½ 1 Mile

Scale 1:20 000

0 5000 Feet

This map is one of a set compiled in 1965 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the Kansas Agricultural Experiment Station.

Range, township, and section corners shown on this map are indefinite.

52

(Joins sheet 45)

R. 1 W.

T. 4 S.

N

WILLOUGHBY CEMETERY

CHICAGO ROCK ISLAND AND PACIFIC

Agenda

Elk Creek

North Fork West Elk Creek

(Joins sheet 51)

(Joins sheet 53)

(Joins sheet 60)

0 ½ 1 Mile

Scale 1:20 000

0 5000 Feet

This map is one of a set compiled in 1965 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the Kansas Agricultural Experiment Station.

Range, township, and section corners shown on this map are indefinite.

(Joins inset, sheet 38)

(Joins sheet 52)

(Joins upper right)

(Joins lower left)

(Joins sheet 60)

R. 1 W.

T. 4 S.

WASHINGTON COUNTY

PRINCIPAL MERIDIAN

SIXTH

CLOUD COUNTY

53

N

0 ½ 1 Mile

Scale 1:20 000

0 5000 Feet

54

(Joins sheet 46)

R. 5 W.

N

Kackley

SALT MARSH CREEK

STATE LAKE

Sl. Johns Creek

Skunk Creek

19 20 21 22

30 29 28 27

31 32 33 34

COUNTY

JEWELL

T. 4 S.

(Joins sheet 55)

CLOUD COUNTY

0 ½ 1 Mile Scale 1:20 000 0 5000 Feet

This map is one of a set compiled in 1965 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the Kansas Agricultural Experiment Station.

Range, township, and section corners shown on this map are indefinite.

R. 5 W. | R. 4 W.

(Joins sheet 47)

55

N

Kackley

T. 4 S.

(Joins sheet 54)

(Joins sheet 56)

ATCHISON, TOPEKA AND SANTA FE

REPUBLICAN RIVER

CLOUD COUNTY

0 ½ 1 Mile

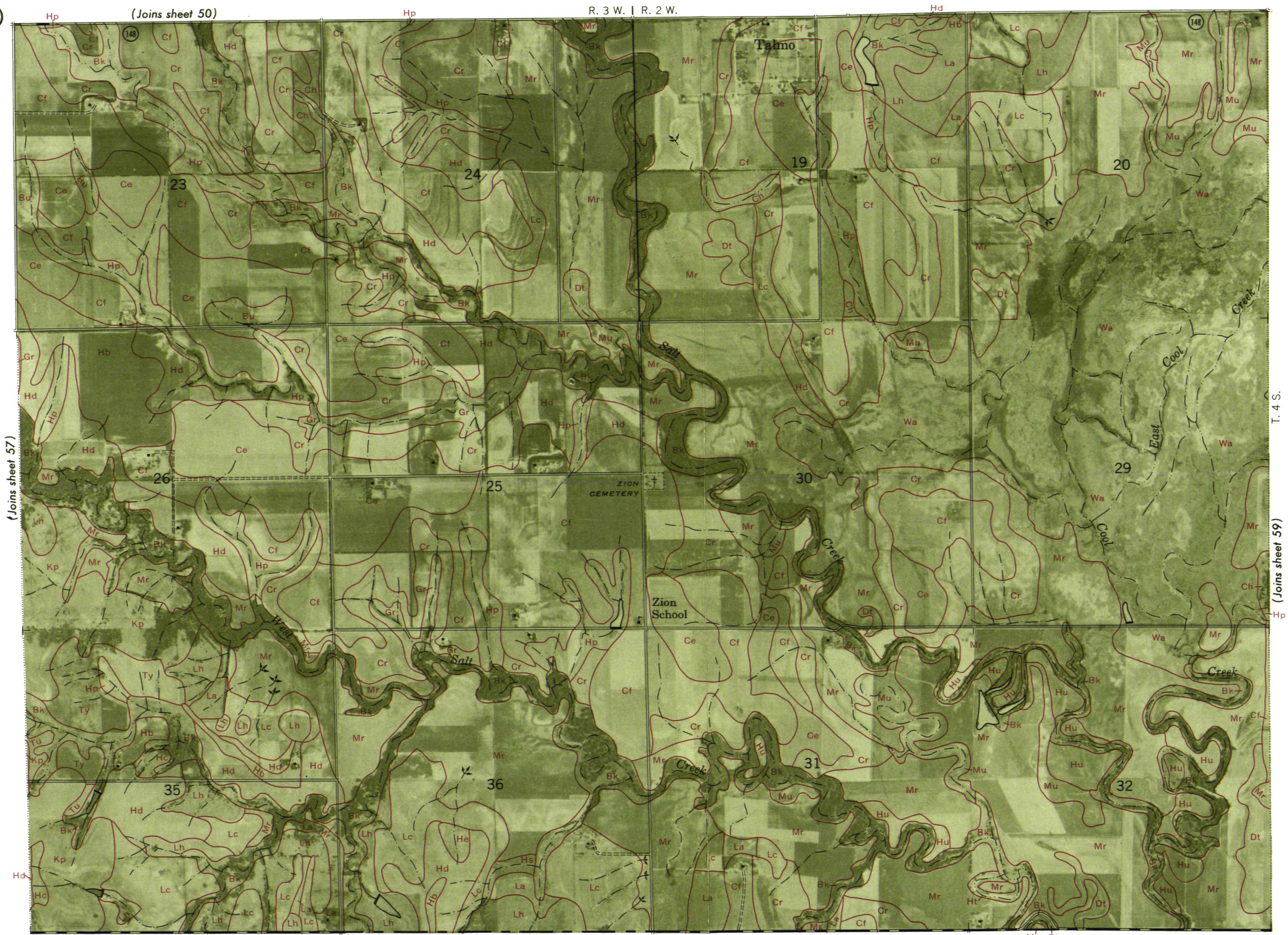
Scale 1:20 000

0 5000 Feet

(Joins sheet 48)
R. 4 W.
56
N
Norway
MISSOURI
PACIFIC
Creek
Lost
Camp
FAIRVIEW CEMETERY
21
22
23
24
25
26
27
28
33
34
35
36
T. 4 S.
(Joins sheet 55)
(Joins sheet 57)
CLOUD COUNTY
0 ½ 1 Mile
Scale 1:20 000
0 5000 Feet

This map is one of a set compiled in 1965 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the Kansas Agricultural Experiment Station.

Range, township, and section corners shown on this map are indefinite.


58
(Joins sheet 50)
R. 3 W. | R. 2 W.
N
Talmo
Salt Creek
Cool Creek
East Cool Creek
ZION CEMETERY
Zion School
West Salt Creek
Salt Creek
T. 4 S.
(Joins sheet 57)
(Joins sheet 59)
23
24
19
20
26
25
30
29
35
36
31
32
148
CLOUD COUNTY
0 ½ 1 Mile
Scale 1:20 000
0 5000 Feet

REPUBLIC COUNTY, KANSAS — SHEET NUMBER 59

R. 2 W.

(Joins sheet 51)

59

N

T. 4 S.

(Joins sheet 58)

(Joins sheet 60)

This map is one of a set compiled in 1965 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the Kansas Agricultural Experiment Station.

Range, township, and section corners shown on this map are indefinite.

CLOUD COUNTY

0 ½ 1 Mile

Scale 1:20 000

0 5000 Feet

60

(Joins sheet 52)

R. 1 W.

N

(Joins sheet 59)

T. 4 S.

(Joins inset, sheet 53)

CHICAGO, ROCK ISLAND AND PACIFIC

MANNING CEMETERY

Elk Creek

Elk Creek

19 20 21 22

30 29 28 27

31 32 33 34

CLOUD COUNTY

0 ½ 1 Mile

Scale 1:20 000

0 5000 Feet